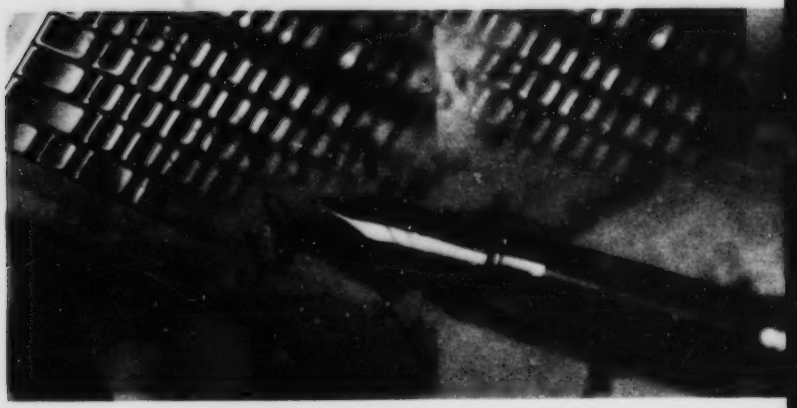
# RESEARCH REPORT

## HIGH-RISE APARTMENT REPAIR NEEDS ASSESSMENT IN THE FORMER CITIES OF TORONTO AND YORK



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# HIGH-RISE APARTMENT REPAIR NEEDS ASSESSMENT IN THE FORMER CITIES OF TORONTO AND YORK

Prepared for:

CMHC
and
The Former Cities of Toronto and York

Prepared by:

Gerald R. Genge
Building Consultants Inc.

1998

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# Executive Summary

# Executive Summary

## Objectives

Recognizing that rental buildings are aging, the condition of high-rise rental housing has been a concern for over 15 years. Previous studies and anecdotal reports on repairs have suggested costs ranging from less than $10,000/unit to over $20,000/unit. What has been absent from the evaluations to date has been a rigorous assessment of actual buildings for real costs for repair. This study provides that assessment.

In addition, this study provides an evaluation protocol that can be used on any high-rise apartment building. The protocol is in the format of a data entry form, so minimal translation is needed to input and analyze the survey results.

Once the characteristics or typology of a building are known, the results of this study can be applied directly to the costing for repairs for the buildings. More importantly, however, the results of this study give a clear picture of the real costs and the range of costs applicable to building repair.

Canada Mortgage and Housing Corporation, as co-sponsors of the study, will find numerous areas for research into cost-effective repair strategies, particularly in the area of the structure, building envelope, mechanical and electrical systems.

Finally, a new "rating" tool for building assessment is presented which affords users of the protocol the opportunity to evaluate and compare the condition of buildings, building systems, and building subsystems without bias applied by costing.

## Participation

The owners of the 63 buildings, in return for anonymity and a condition and capital cost program report, allowed access to their buildings. Their cooperation is gratefully acknowledged. As well, the assistance and guidance of The City of Toronto Housing Department, The (former) City of York Planning Department, The Fair Rental Policy Organization of Ontario, The Ontario Ministry of Municipal Affairs and Housing, and Canada Mortgage and Housing Corporation is gratefully acknowledged.

## Methodology

The study of a sample of 63 high-rise buildings was completed using an evaluation protocol developed to quickly gather information in a format that was data-entry ready. Analysis of the data on seven major building systems, comprised of 21 different major building subsystems, was conducted using a Microsoft Access-based database. This report provides a summary of the findings, including the typology of the buildings, typical complaints, and repair costs on a per-unit basis. In addition, information on energy conservation measures, albeit minimal within the scope of this study, is appended.

To assist in assessing the condition of the buildings as a whole, a new rating tool was devised. The 'rating' value was assessed for each system and then calculated for each building to help establish an appropriate gauge of the condition of the building. The building condition could be incorrectly gauged if per-unit costs alone were used as the measure of condition. The rating tool is expected to be useful in future to compare conditions found now and later, and to compare the condition of buildings in different cities.

The findings are described and cross-relationships are made against the following criteria:

1. The four age groups surveyed, i.e. pre-1960s, 1960s, 1970s and post-1970s buildings.
2. The four time frames for repair, i.e. Immediate, 1 to 2 years, 3 to 5 years, and 6 to 10 years.

The seven primary building systems and 21 building subsystems are used to establish a typology for the buildings within the four age groups. The systems and subsystem are as follows:

## Building Systems and Subsystems Reviewed

| | |
|---|---|
| *Site* | *Pavement and Walkways* (asphalt, concrete, interlock)<br>*Site Structures* (retaining walls, pools, fences, security building) |
| *Structure* | *Garage* (slabs, columns and walls, waterproofing)<br>*Balcony* (slabs and guards)<br>*Building Framing* (exposed Structure) |
| *Building Envelope* | *Exterior Walls* (cladding material and design)<br>*Windows and Exterior Doors* (configuration, framing materials, glazing type, sealants)<br>*Roofs* (configuration, materials) |
| *Mechanical* | *Heating and Cooling* (boilers, pipe, valves)<br>*Ventilation* (make-up air and exhaust systems)<br>*Domestic Water* (hot and cold water supply, boilers, pipe, valves, pumps)<br>*Drainage* (sanitary and storm pipe, sumps and pumps)<br>*Plumbing Fixtures and Trim* (bathroom and kitchen fixtures and valves) |
| *Electrical* | *Power Supply and Distribution* (supply, disconnects and sub-panels, suite panels and wiring)<br>*Lighting* (corridor, stair, garage, suite and common lighting controls, lamps and coverage)<br>*Auxiliary Systems* (Telephone, CATV, CCTV, security, building entry, and heat tracing) |
| *Life Safety* | *Fire Suppression* (fire standpipe, sprinklers, siamese connections, fire and jockey pumps)<br>*Fire Alarm and Voice Communication* (annunciator and control panels, audibility, handsets and paging, compliance with fire code)<br>*Emergency Power* (generator and/or batteries, lighting systems and duration) |
| *Elevators* | *Equipment* (equipment controllers, drive system)<br>*Cars and Floor Call* (indicators, call buttons, door controllers) |

# Key Findings

## Ownership

Seventy percent of the buildings in the sample have been held by the same owners for more than 10 years. This includes 75% of the pre-1960s buildings, 68% of the 1960s buildings, 100% of the 1970s buildings and 45% of the post-1970s buildings. The reduced tenure in post-1970s buildings reflects the building age. There appeared to be a possible significance to the term of ownership in the repair costs in that buildings owned from 1 to 5 years had lower cost than buildings owned either less than 1 year or more than six years. This would require a more exhaustive evaluation than possible with the data obtained.

## Management

Management of the buildings is more volatile than ownership with only *25%* to 29% of the managers having been with the same building for more than 10 years in the pre-1960s and 1960s buildings and 63% in the 1970s buildings. No post-1970s buildings reported the same management for more than 10 years. No obvious cost implications were evident in the data based on tenure of management.

## Superintendence

Superintendence of the buildings is also more volatile than ownership with only 21% to 31% of the superintendents having been with the same building for more than 10 years. No post-1970s buildings reported the same superintendent for more than 10 years. No obvious cost implications were evident in the data based on tenure of superintendence. Historical information on the building repairs was generally inadequate since it was the superintendents that were relied upon to complete the forms for the past repairs.

## Average Costs For Building Repair

All costs are expressed in terms of dollars per apartment unit. The distribution of costs is shown on Chart 1: "Replacement Costs by Time Frame and Building Component" on the following page. As can be seen on the chart, the costs have been distributed over four time periods for the seven building systems.

The greatest cost in the Immediate period and the 1 to 2 year period applies to the Structure and Building Envelope. The greatest cost in the 3 to 5 year period and the 6 to 10 year period applies to the Mechanical and Electrical systems. Elevators produce high costs in 3 to 5 years. Life Safety system repairs are generally low cost as most have been done.

The average cost/unit based on an average of total per-unit costs for each building is $7,474 for all work over ten years. The range of costs is from a low of $124/unit to a high of $21,258/unit. Given this range of cost values, it is clear that averages can be misleading, as the distribution of costs is masked.

The Appendices to the report provide a very thorough assessment of costs giving the frequency distribution, or histograms, for cost/unit for each building subsystem. The text of the report gives an assessment of the distribution in terms of quartile costs (the cost to repair 25%, 50% and 75% of the population) and the maximum cost. In most cases, there are significant differences in the costs for the 25% or lower quartile and the 75% levels. The maximum cost, in most cases, is also far greater than reflected in the average cost.

The averages for each building system and the 75% and maximum costs for each building subsystem are summarized in the following sections.

## Cost Distribution By Building System

### Site

Costs are not particularly high. The greatest average cost for repair is in 1 to 2 years at $51/unit over 10 years for all buildings. Complaints relate to potholes and centre mainly on the pre-1960s and 1960s buildings.

#### Pavement And Walkways

The work is typically pavement replacement and repair. The greatest 75% cost involves pre-1960s buildings at $202/unit and the maximum cost is a 1960s building at $620/unit.

#### Site Structures

The work is typically fence and retaining wall replacement and repair. The greatest 75% cost involves pre-1960s buildings at $35/unit and the maximum cost is a post-1970s building at $194/unit that requires retaining wall repair.

### Structure

Exposed structural concrete, primarily garage and balcony repairs, remain as important issues to be addressed by building owners. The greatest average cost for the repairs is in 1 to 2 years at $591/unit. This involves the 1960s and 1970s buildings. Of concern is the absence of a protective waterproofing membrane on the suspended slabs on 40% to 60% of the buildings. This results in high repair costs, as well as the common complaint about floor slab leaking.

#### Garage

The work is typically slab repair and waterproofing. The greatest 75% cost involves 1960s buildings at $906/unit and the maximum cost is a 1960s building at $4,126/unit.

#### Balconies

The work is typically slab repair and guard replacement. The greatest 75% cost involves 1960s buildings at $678/unit and the maximum cost is a 1960s building at $1,798/unit.

#### Building Framing

The work is typically slab edge and shear wall repair. The greatest 75% cost involves 1960s buildings at $228/unit and the maximum cost is a 1960s building at $1,277/unit.

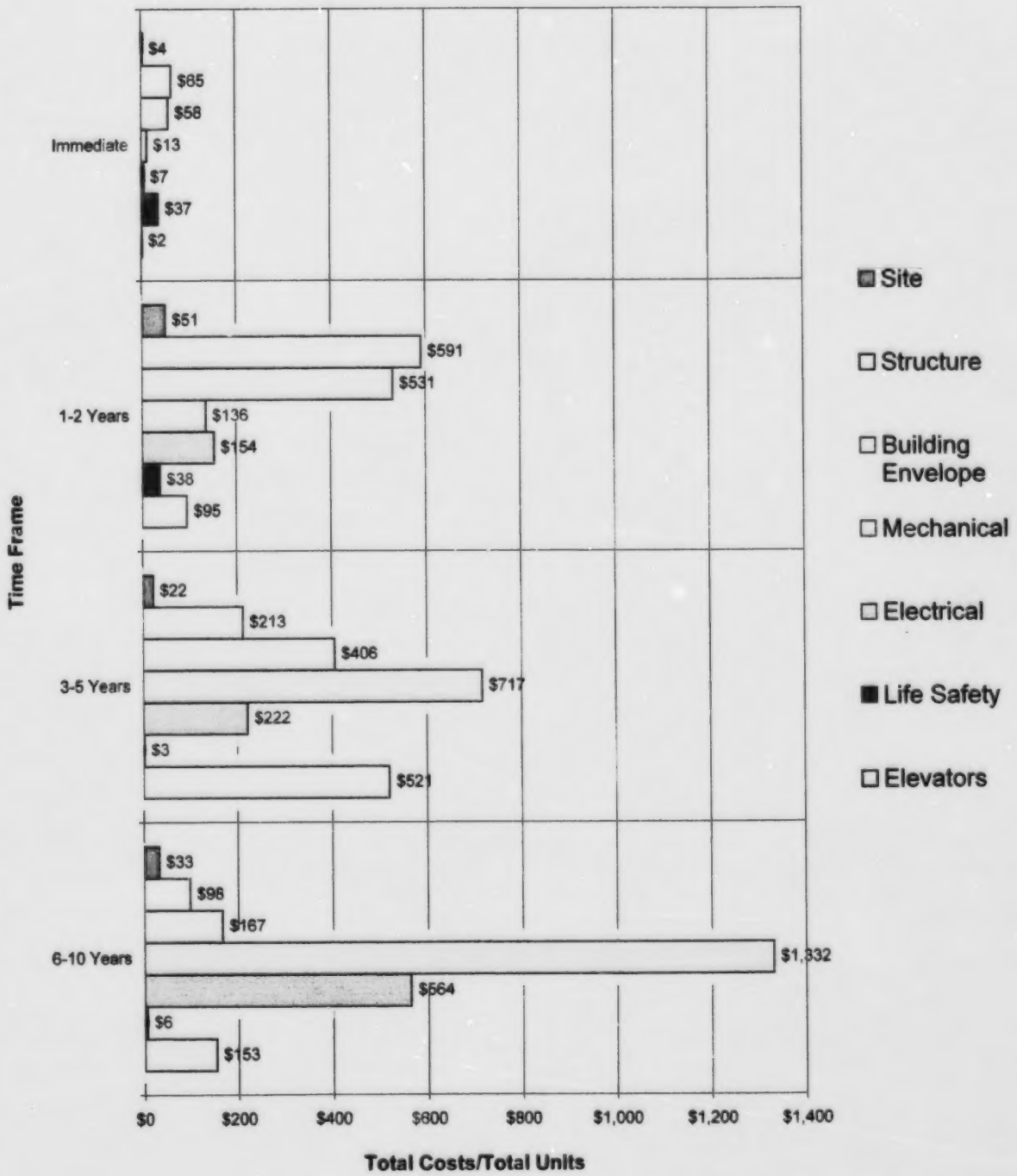
### Building Envelope

The exterior walls, windows and exterior doors, and roofs are also high cost systems in the shorter term yielding an average cost of $531/unit in 1 to 2 years and $408/unit in 3 to 5 years. Complaints about exterior walls generally refer to leaks. Complaints at windows generally refer to condensation and/or to leaks. Complaints about roofs generally refer to leaks.

#### Exterior Walls

The work is typically brick replacement. The greatest 75% cost involves pre-1960s buildings at $390/unit and the maximum cost is a pre-1960s building at $1,443/unit. The costs/unit for the post-1970s buildings involving cavity and rain screen-style walls, do not differ much from the cost for walls employing thin cavities or solid wall designs.

## Chart 1. Replacement Costs by Time Frame and Building Component



### Windows

The work is typically resealing the window perimeters and cap bead sealant; however, higher costs are associated with window replacement. The greatest 75% cost involves 1960s buildings at $1,469/unit and the maximum cost is a pre-1960s building at $4,857/unit. Seventy-five percent of the pre-1960s buildings and 50% of the 1960s building have replaced windows; still, there is a common complaint about leaks and condensation. This would lead to the assumption that the windows were inadequate due to the design, or installation, failing to meet the need.

### Exterior Doors

The work is typically associated with balcony door replacement. The greatest 75% cost involves 1960s buildings at $142/unit and the maximum cost is a 1960s building at $1,935/unit.

### Roofs

The work is typically roof replacement. The greatest 75% cost involves pre-1960s buildings at $703/unit and the maximum cost is a 1960s building at $1,687/unit. The data indicates that a high proportion of the roofs of the pre-1960s and 1960s buildings have been replaced. The complaints in 25% of the pre-1960s and 1960s and 36% of the post-1970s buildings are generally that the roofs leak.

## Mechanical

The heating and cooling systems, ventilation, domestic water, drainage, and plumbing are high cost systems in the longer term yielding an average cost of $717/unit in 3 to 5 years and $1,332/unit in 6 to 10 years. Complaints about mechanical systems generally refer to lack of heat, valves that do not seal and lack of control of heat. Complaints about ventilation systems generally refer to humidity and odours. Complaints about the domestic water generally refer to pipe leaks, inadequate pressure in older buildings and valves not sealing. Complaints about drainage relate to back-sudsing at lower floors and ponding in the garage. Complaints about plumbing are about leaking fixtures and faucets, valves that do not seal, and lack of temperature control.

### Heating And Cooling

The work is typically replacement of pipe and boilers. The greatest 75% cost involves pre-1960s buildings at $2,742/unit and the maximum cost is a pre-1960s building at $3,550/unit. The pre-1960s buildings have boilers that average 26 years old, indicating they are overdue for replacement.

### Ventilation

The work is typically replacement of make-up air units. The greatest 75% cost involves pre-1960s buildings at $2,526/unit and the maximum cost is a pre-1960s building at $3,143/unit. Almost half of the pre-1960s buildings have no corridor pressurization, accounting for the lack of ventilation and the complaints.

### Domestic Water

The work is typically replacement of pipe and boilers. The greatest 75% cost involves pre-1960s buildings at $1,804/unit and the maximum cost is a 1960s building at $2,540/unit. The buildings generally have boilers that average 10 to 15 years old, indicating they are due for replacement.

### Drainage - Sanitary And Storm

The work is typically replacement of failed and plugged pipe. The greatest 75% cost involves pre-1960s buildings at $290/unit and the maximum cost is a pre-1960s building at $563/unit.

### Plumbing - Fixtures And Trim

The work is typically replacement of old and failed fixtures and trim. The greatest 75% cost involves pre-1960s buildings at $1,712/unit and the maximum cost is a pre-1960s building at $2,278/unit. A high percentage of the fixtures are new in the pre-1960s and 1960s buildings. The 1970s and later buildings have generally not conducted replacements.

## Electrical

The power supply and distribution, lighting, and auxiliary systems are high cost systems in the longer term yielding an average cost of $564/unit in 6 to 10 years. Complaints about power supply systems generally refer to over-fusing and panels with no additional capacity. Complaints about lighting systems generally refer to low light levels in some areas and general poor condition. Complaints about the auxiliary systems generally refer to the building entry systems malfunctioning.

### Power Supply And Distribution

The work is typically a general upgrade of the system. The greatest 75% cost involves pre-1960s buildings at $2,917/unit and the maximum cost is a pre-1960s building at $5,250/unit. The older buildings generally have overtaxed systems that are over-fused, with no grounding, and due for replacement.

### Lighting

The lighting has been upgraded to energy efficient fixtures in most older buildings, so the work is typically replacement in the buildings not yet retrofit. The greatest 75% cost involves pre-1960s buildings at $199/unit and the maximum cost is a 1960s building at $549/unit.

### Auxiliary Systems

The telephone system and cable TV require minimal work by the owners. The majority of the work is on the building entry systems, typically involving replacement in the buildings. The greatest 75% cost involves 1970s buildings at $94/unit and the maximum cost is a pre-1960s building at $560/unit.

## Life Safety

The life safety systems, fire suppression, fire alarm and voice communication, and emergency power, are low cost systems yielding an average cost of $38/unit in 1 to 2 years and $3/unit to $7/unit in the other time frames. There are no recorded complaints about suppression systems. Alarm system complaints typically involve low audibility and false alarm indications. Emergency power system complaints are few but involve light brightness, generators not starting or devices not connected. The systems have generally been upgraded to comply with the fire code, OR 627/92.

### Fire Suppression

The fire suppression has been upgraded to OR 627/92 in most buildings, so the work is typically upgrades in those that have not fully complied. The greatest 75% cost involves pre-1960s buildings at $79/unit and the maximum cost is a pre-1960s building at $220/unit.

### Fire Alarm And Voice Communication

The fire alarm and voice communication systems have been upgraded to OR 627/92 in most buildings so the work is typically upgrades in those that have not fully complied or have no system. The greatest 75% cost involves 1970s buildings at $114/unit and the maximum cost is a pre-1960s building at $786/unit.

### EMERGENCY POWER

The emergency power systems have been upgraded in most buildings, so the work is typically replacement of batteries or lights. The greatest 75% cost involves pre-1960s buildings at $105/unit and the maximum cost is a 1960s building at $507/unit.

### ELEVATORS

The elevators, equipment, controllers, and car/door systems are high cost, high maintenance systems yielding an average cost of $564/unit in 3 to 5 years and ranging from $2/unit to $153/unit in the other time frames. The complaints are few but include cars not responding, excessive out-of-service and bouncy or rough ride.

The elevator systems are routinely inspected and serviced; however, upgrading has not been done in most buildings, so, the work is typically replacement of controllers and equipment that is due for renewal. The greatest 75% cost involves pre-1960s buildings at $2,115/unit and the maximum cost is a 1960s building at $3,651/unit.

## Cost Distribution Affected By Age Of Building

### Pre-1960s Buildings

Over the next 10 years, the pre-1960s buildings exhibit the highest per-unit costs ranging from approximately $4,000/unit at the 25% level to roughly $17,000/unit at the 75% level, to a maximum of over $21,000/unit. This age group includes buildings of the 1930s that have need of substantial work in several areas.

### 1960s Buildings

Over the next 10 years, the 1960s buildings exhibit the highest total costs being the largest group. The costs range from approximately $5,000/unit at the 25% level to roughly $9,500/unit at the 75% level, to a maximum of over $17,500/unit. This age group includes the majority of the buildings.

### 1970s Buildings

The 1970s buildings have a typology much like the 1960s buildings; however they are newer. Over the next 10 years, costs range from approximately $1,500/unit at the 25% level to roughly $4,500/unit at the 75% level, to a maximum over $6,000/unit. This age group will also exhibit costs like the buildings of the 1960s if work is not done.

### Post-1970s Buildings

The post-1970s buildings in this sample are all largely social housing, as private rental housing fell off dramatically following the initializing of rent control in 1975. Over the next 10 years, costs range from approximately $500/unit at the 25% level, to roughly $3,500/unit at the 75% level, to a maximum of over $7,000/unit.

## Impact Of Costs On Owners

The cost for the repairs outlined in this study would typically be recovered from rental income. Calculation based on $751/month average gross income have been made for the 25%, 50%, 75%, and the maximum costs. While the majority of the subsystems can be repaired over the next ten years at a cost of less than 1% of the gross income over the ten-year period, there are several systems that produce higher costs.

The benchmark used for the assessment is the 75% level; that is, the level at which 75% of the buildings cost less than the 75% amount. At the 75% level, the subsystems that cost 1% or more include:

- Garages of the 1960s buildings at 1.0%,
- Windows of the 1960s buildings at 1.63%,
- Heating and cooling systems of the pre-1960s buildings at 3.04%,
- Ventilation systems of the pre-1960s buildings at 2.80%,
- Domestic water in the pre-1960s buildings at 2.0%,
- Plumbing in the pre-1960s buildings at 1.9%,
- Power supply and distribution in the pre-1960s and the 1960s buildings at 3.24% and 1.67%, respectively,
- Elevators in the pre-1960s and the 1960s buildings at 2.35% and 1.9%, respectively.

A separate assessment has also been made for the seven most costly buildings. The total costs for these buildings over the next ten years ranges form 17.2% to 23.6% of the gross income. Undoubtedly, the owners of some buildings will be unable to make repairs without significant financial hardship or assistance of some kind.

### ENERGY ISSUES

Energy retrofits for lighting have been completed by most building owners; however, very few other improvements have been made. This may be due to slow payback and other recovery non-incentives. Owners were generally not willing to provide information on the savings, even in qualitative form,

## Use of the Survey Protocol and Results

The survey premise of using experts was a highly cost effective way to gather data on the condition of buildings and the costs for repair. The format of gathering data using data entry forms permitted a generally consistent and structured method for recording and inputting information into a database. Data entry should, however, be performed by people skilled at building evaluation, as inconsistencies and explanatory notes added by the auditors still require interpretation.

For future studies, it is expected that large populations of buildings (25 or more) should be able to be surveyed, data entered and assessment made for roughly $5,000 per building.

### ASSESSMENT BY THE "RATING" FACTOR

A new assessment tool, the "building rating" factor or "rating" has been applied to each subsystem. The rating assesses the time to repair and the impact of a failure on the safety and use of the building. Costs do not weigh in the rating; however, weight is applied to safety and use of the building or system.

The cost/unit assessment of all buildings in the sample provided a frequency distribution histogram that was clearly skewed to the right (skewness of 0.93) indicating several high cost buildings. The "rating" histogram for all buildings indicates a symmetrical distribution, having a coefficient of skewness of 0.01. Perfect symmetry would have a skewness of 0. The kurtosis, or tendency for the values to concentrate near the mean value, calculated for the cost/unit for all buildings is 0.63 and -0.65 for the "ratings". A 'normal curve' has a kurtosis of 3. The data distribution is, therefore, somewhat flattened in both the cost/unit and the rating analysis. This indicates a wide range of costs and ratings.

Ratings are comparable between buildings for a given system or subsystem but not between building systems either in the same building or between buildings.

The average rating for all buildings in the sample is 414. The range is from 98 to 721. The high quartile buildings, those in the worst condition, would have a value greater than approximately 520 to 540.

### USE OF THE RESULTS

The results of this study can be used to provide baseline data on the condition and costs for building repair in the Toronto area. Should the protocol used in this study be used on a similar sample in 5 to 10 years, the costs/unit and the ratings values obtained could readily be compared to this study, thus giving a benchmark for the status of the housing stock.

The results of this study could be compared to studies performed on buildings in other centres with large housing stocks of similar vintages, such as Vancouver, Montreal, or Ottawa. This would provide an indication of possible effects of environmental exposure, building typology or, possibly, rent control legislation.

The results of this study can also be used to extrapolate costs to the sample universe and, assuming a similar building typology, to housing stock in the areas neighbouring Toronto and York, where the study was conducted. An extrapolation of the total cost for Toronto/York is given below.

# Extrapolation of the Results

## Extension To Other Centres

Should the data be extended to other centres, the typology of the buildings must be confirmed as similar or matching that in this study. Errors in costing will result if the buildings are not of similar design and construction.

Further, the data should not be extended across age groups as the age of the building has been determined to be the primary trigger for repair.

## Extension To Toronto/York

The total cost for building repair in Toronto and York over the next ten years is calculated at $416 Million. This value has been calculated on the basis of the total cost for buildings in each age group over the ten year period and the actual number of buildings in the sample universe. Simple extrapolation on the basis of a ratio of units in the sample population to the units in the sample universe overestimates the cost due to the influence of a slight over-sampling of 1930s buildings.

The breakdown of total costs is as follows:

| | | |
|---|---|---|
| **Immediate** | $14,775,000 | *mainly Structure and Life Safety* |
| **1 to 2 years** | $105,687,000 | *mainly Structure and Building Envelope* |
| **3 to 5 years** | $137,374,000 | *mainly Mechanical and Elevators* |
| **6 to 10 years** | $157,897,000 | *mainly Mechanical and Electrical* |
| **Total** | **$415,733,000** | |

## Comparison With Other Studies

The total value of the repair work over the next ten years is comparable to that calculated using less sophisticated means in 1992 as an output of the Apartment Conservation Study and with a value calculated in 1984 as an output of the Study of Residential Intensification and Rental Housing Conservation. The cost projected by the Apartment Conservation Study was $391 Million over ten years for the former City of Toronto. Applying a correction to include York would result in $457 Million over ten years. The cost projected by the Study of Residential Intensification and Rental Housing Conservation was $10,000/unit over 20 years or roughly $721 Million for this sample. The additional ten years represents a 73% increase in costs.

The costs arrived at in this study are based on the actual survey of 63 buildings and are considered to be a true projection of the real repair need.

# Sommaire

## Objectifs

Puisqu'on sait que les immeubles locatifs prennent de l'âge, l'état du parc de tours d'habitation est un sujet de préoccupation depuis plus de 15 ans. Selon des études et des rapports isolés sur des réparations, le coût des réparations à effectuer oscillerait entre 10 000 et 20 000 dollars par logement. Cependant, on n'a jamais mené une évaluation rigoureuse des immeubles pour en déterminer le coût réel des réparations. La présente étude fournit justement cette évaluation.

En outre, cette étude expose un protocole d'évaluation pouvant être appliqué à n'importe quelle tour d'habitation. Ce protocole se présente comme une formule de saisie de données, d'où le peu d'interprétation nécessaire dans la saisie et l'analyse des résultats du sondage.

Une fois qu'on connaît les caractéristiques ou le type d'un immeuble, on peut appliquer directement les résultats de l'étude à l'établissement des coûts de réparation de l'immeuble. Qui plus est, les résultats de l'étude brossent un tableau précis des coûts réels et de l'éventail des coûts de réparation s'appliquant à l'immeuble.

La Société canadienne d'hypothèques et de logement, qui a coparrainé l'étude, y trouvera de nombreux domaines de recherche sur les stratégies rentables de réparation, et en particulier dans les domaines de la structure, de l'enveloppe du bâtiment, des installations techniques et des systèmes électriques.

Enfin, nous présentons un nouvel outil de notation pour l'évaluation des immeubles, lequel permet aux utilisateurs du protocole d'évaluer et de comparer l'état des bâtiments, de leurs systèmes et de leurs sous-systèmes sans l'inconvénient du biais typique de l'évaluation des coûts.

## Participation

Les propriétaires de 63 immeubles, en retour de l'anonymat et d'un rapport sur l'état de leurs immeubles et le programme des frais d'investissement, nous ont donné accès à leurs immeubles. Nous les remercions sincèrement de leur collaboration. De plus, l'aide et les conseils du City of Toronto Housing Department, du City of York Planning Department (maintenant dissous), du Fair Rental Policy Organization of Ontario, du ministère des Affaires municipales et du Logement de l'Ontario et de la Société canadienne d'hypothèques et de logement nous ont été très précieux.

## Méthode

L'étude portant sur un échantillon de 63 tours d'habitation a été menée à l'aide d'un protocole d'évaluation mis au point pour permettre la collecte rapide de renseignements sous une forme se prêtant facilement à leur saisie dans un ordinateur. À l'aide d'une base de données créée avec Microsoft Access, nous avons effectué une analyse des données de sept principaux systèmes dans les bâtiments, systèmes se divisant en 21grands sous-systèmes différents. Le présent rapport donne un aperçu des constatations tirées de cette analyse, y compris des caractéristiques des immeubles, des plaintes typiques et des coûts des réparations par logement. De plus, nous y avons annexé des données sur les mesures de conservation de l'énergie mêmes minimales compte tenu de la portée de l'étude.

Pour faciliter l'évaluation de l'état des immeubles en général, nous avons mis au point un nouvel outil de notation. Nous avons attribué une note à chaque système et calculé la note de chaque immeuble afin de faciliter la détermination pertinente de l'état de l'immeuble. L'évaluation de l'état des immeubles aurait pu être imprécise si

nous avions utilisé comme seule mesure les coûts des réparations par logement. Nous prévoyons que l'outil de notation s'avérera utile, car il permettra la comparaison de l'état actuel des immeubles à leur état éventuel et la comparaison des immeubles de diverses villes.

La description des constatations et l'établissement de relations croisées se fondent sur les critères suivants :

1. Les quatre groupes d'âge à l'étude, c'est-à-dire les immeubles d'avant 1960, ceux des années 1960, ceux des années 1970 et, enfin, ceux d'après 1979.
2. Les quatre périodes de réparation, notamment : Immédiatement, dans 1 ou 2 ans, dans 3 à 5 ans et, enfin, dans 6 à 10 ans.

Les 7 principaux systèmes dans les bâtiments et leurs 21 sous-systèmes sont utilisés pour établir les caractéristiques des immeubles dans les quatre groupes d'âge. Les systèmes et les sous-systèmes en question sont les suivants:

## Systèmes et sous-systèmes examinés dans les bâtiments

| | |
|---|---|
| *Terrain* | *Allée pour voitures et allées piétonnières* (asphalte, béton, pavés autobloquants)<br>*Structures sur le terrain* (murs de soutènement, piscines, clôtures, bâtiment de sécurité) |
| *Structure* | *Garage* (dalles, poteaux et murs, imperméabilisation à l'eau)<br>*Balcons* (dalles et parapets)<br>*Charpente* (charpente exposée) |
| *Enveloppe des bâtiments* | *Murs extérieurs* (matériaux de bardage et conception)<br>*Fenêtres et portes extérieures* (configuration, matériaux de cadre, type de vitrage, mastics)<br>*Toitures* (configuration, matériaux) |
| *Installations techniques* | *Chauffage et climatisation* (chaudières, conduits, soupapes)<br>*Aération* (air d'appoint et systèmes d'évacuation)<br>*Eau domestique* (alimentation en eau chaude et froide, chauffe-eau, conduits, soupapes, pompes)<br>*Drainage* (égout sanitaire, égout pluvial, puisards et pompes)<br>*Appareils de plomberie et garnitures* (soupapes et appareils des cuisines et des salles de bains) |
| *Systèmes électriques* | *Alimentation et distribution électrique* (alimentation, sectionneurs, sous-panneaux, panneaux des logements et câblage)<br>*Éclairage* (corridors, escaliers, garage, interrupteurs de l'éclairage des logements et des aires communes, lampes et superficie couverte)<br>*Installations auxiliaires* (téléphone, câblodistribution, télévision en circuit fermé, sécurité, entrée de l'immeuble, réchauffage des conduits) |
| *Sécurité des occupants* | *Extinction des incendies* (colonne montante, sprinklers, raccords pompier, pompes à incendie et de type jockey)<br>*Alarme incendie et Interphone* (annonciateur et tableaux de contrôle, audibilité, combinés et appareils de communication interne, respect du Code de prévention des incendies)<br>*Courant de secours* (génératrice et/ou batteries, systèmes d'éclairage et durée) |
| *Ascenseurs* | *Équipement* (unités de commandes de l'équipement, système d'entraînement)<br>*Cabines et commandes des étages* (voyants, boutons d'appel, dispositifs de commande des portes) |

# Principales constatations

## PROPRIÉTAIRES

Parmi l'échantillon, 70% des immeubles ont appartenu aux mêmes propriétaires durant plus de 10 ans, soit 75% des immeubles d'avant 1960, 68 % de ceux des années 1960, 100 % de ceux des années 1970 et 45% des immeubles d'après 1979. Dans les immeubles d'après 1979, la réduction de la période d'appartenance au même propriétaire est le reflet de l'âge des immeubles. La durée de la période d'appartenance au même propriétaire semble se répercuter sur le coût des réparations, car ceux qui étaient propriétaires depuis 1 à 5ans avaient assumé moins de coûts que ceux qui l'avaient été moins de 1 an ou plus de 6 ans. Pour déterminer les raisons, il nous faudrait réaliser une évaluation plus exhaustive que l'information permettait.

## GESTIONNAIRES

Le taux de roulement des gestionnaires est supérieur à celui des propriétaires, car les gestionnaires s'étant occupé du même immeuble pendant plus de 10 ans s'élèvent à seulement 25 à 29% dans les immeubles d'avant 1970 (y compris ceux d'avant 1960) et à 63% dans les immeubles des années 1970. Aucun immeuble d'après 1970 n'a eu le même gestionnaire durant plus de 10 ans. Aucune implication évidente sur les coûts n'est ressortie des données reposant sur la période d'affectation des gestionnaires.

## CONCIERGES

Le taux de roulement des concierges est également supérieur à celui des propriétaires, car les concierges affectés au même immeuble durant plus de 10 ans n'atteignent que 21 à 31% de l'ensemble des concierges. Aucun immeuble d'après 1970 n'a eu le même concierge durant plus de 10 ans. Aucune implication évidente sur les coûts n'est ressortie des données reposant sur la période d'affectation des concierges. Les données historiques sur les réparations apportées aux immeubles étaient généralement inadéquates, car il incombe aux concierges de remplir les formules touchant les réparations effectuées.

## COÛT MOYEN DES RÉPARATIONS APPORTÉE S AUX IMMEUBLES

Tous les coûts sont exprimés en dollars par logement. La répartition des coûts est indiquée dans le Tableau 1, Coûts de remplacement selon la période d'exécution et le composant du bâtiment, à la page suivante. Comme ce tableau permet de le constater, les coûts ont été répartis en quatre périodes pour sept systèmes dans les bâtiments.

Le coût le plus élevé pour la période Immédiatement et la période 1 à 2 ans touche la structure et l'enveloppe des bâtiments. Le coût le plus élevé pour la période 3 à 5 ans et la période 6 à 10 ans touche les installations techniques et les systèmes électriques. Les coûts les plus élevés pour les ascenseurs se trouvent dans la période 3 à 5 ans. Le coût des réparations des systèmes assurant la sécurité des occupants est généralement faible, car la plupart de ces réparations ont déjà été effectuées.

La moyenne des coûts totaux des réparations par logement s'élève à 7474 dollars pour l'ensemble des travaux à exécuter dans dix ans. Ces coûts se situent entre 124 dollars et 21258 dollars par logement. Compte tenu de l'importance de cet écart, il est clair que les moyennes sont trompeuses, car la répartition des coûts s'en trouve voilée.

Les annexes du rapport fournissent une évaluation exhaustive des coûts indiquant la répartition des fréquences, ou histogrammes, par coût et logement pour chaque sous-système dans les bâtiments. Le corps du rapport fournit une évaluation de la répartition des coûts par quartile (coûts entraînés par la réparation de 25%, 50% et 75% des logements) et le coût maximal. Dans la plupart des cas, un écart considérable sépare les coûts du quartile à 25% de ceux du quartile à 75%. Le coût maximal est aussi la plupart du temps de beaucoup supérieur au coût moyen.

Dans les rubriques suivantes, nous résumons les moyennes de chaque système dans les bâtiments de même que les coûts du quartile à 75% et le coût maximal de chaque sous-système dans les bâtiments.

## RÉPARATION DES COÛTS PAR SYSTÈME DANS LES BÂTIMENTS

### TERRAIN

Les coûts ne sont pas particulièrement élevés. Le coût moyen le plus élevé se trouve dans la période de 1 à 2 ans, soit 51 dollars par logement sur une période de 10 ans pour l'ensemble des bâtiments. Les plaintes portent sur des nids de poule et touchent surtout les immeubles d'avant 1960 et ceux des années 1960.

#### ALLÉE POUR VOITURES ET ALLÉES PIÉTONNIÈRES

Les travaux touchent typiquement le remplacement ou la réparation de la chaussée (ou des pavés). Le quartile à 75 % dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 202 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 620 dollars par logement.

#### STRUCTURES SUR LE TERRAIN

Les travaux touchent typiquement le remplacement ou la réparation de clôtures et de murs de soutènement. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 35 dollars par logement, et le coût maximal touche un immeuble d'après 1979 dont un mur de soutènement a besoin d'une réparation s'élevant à 194 dollars par logement.

### STRUCTURE

Les réparations au béton structural exposé, principalement le garage et les balcons, constituent un problème important que doivent régler les propriétaires des immeubles. Le coût moyen des réparations le plus élevé se trouve dans la période de 1 à 2 ans, soit 591 dollars par logement, et touche les immeubles des années 1960 et 1970. L'absence d'une membrane d'étanchéité sur les dalles suspendues dans 40 % à 60 % des immeubles est un élément de préoccupation, qui entraîne des coûts de réparation élevés et provoque couramment des plaintes au sujet de l'infiltration d'eau par les dalles.

#### GARAGE

Les travaux touchent typiquement la réparation et l'imperméabilisation de la dalle. Le quartile à 75 % dont les coûts sont les plus élevés concerne les immeubles des années 1960, soit 906 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 4126 dollars par logement.

#### BALCONS

Les travaux touchent typiquement la réparation de la dalle et le remplacement du parapet. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1960, soit 678 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 1 798 dollars par logement.

#### CHARPENTE

Les travaux touchent surtout la réparation du contour des dalles et de murs de contreventement. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1960, soit 228 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 1277 dollars par logement.

### ENVELOPPE DES BÂTIMENTS

Les murs extérieurs, les fenêtres, les portes extérieures et les toitures sont des systèmes dont la réparation suppose des coûts élevés à court terme, la moyenne par logement s'établissant à 531 dollars pour la période de 1 à 2 ans et à 408 dollars pour la période de 3 à 5 ans. Les plaintes au sujet des murs extérieurs portent généralement sur l'infiltration d'eau. Les plaintes au sujet des fenêtres touchent généralement la condensation et/ou l'infiltration d'eau. Les plaintes au sujet des toitures font référence à des infiltrations, en général.

### Murs Extérieurs

Les travaux à exécuter touchent typiquement le remplacement de briques. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 390 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 1143dollars par logement. Pour les immeubles d'après 1979, le coût des réparations à effectuer aux murs creux et à écran pare-pluie ne diffère pas beaucoup de celui touchant des murs pleins ou à interstices minces.

### Fenêtres

Les travaux consistent typiquement à étanchéiser de nouveau les périmètres des fenêtres et à refaire le calfeutrage périmétrique des fenêtres; toutefois, les coûts les plus élevés touchent le remplacement des fenêtres. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1960, soit 1469 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 4857 dollars par logement. Les fenêtres de 75% des immeubles d'avant 1960 et de 50% de ceux des années 1960 ont été remplacées; néanmoins, les locataires se plaignent couramment d'infiltrations d'eau et de condensation. Cette réalité laisse à penser que les fenêtres étaient inadéquates en raison de leur conception ou de leur installation et qu'elles n'ont donc pas rempli leur mission.

### Portes Extérieures

Les travaux touchent typiquement le remplacement des portes de balcon. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1960, soit 142 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 1935 dollars par logement.

### Toitures

Les travaux touchent typiquement le remplacement de la toiture. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 703 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 1687 dollars par logement. Selon les données recueillies, la majeure partie des toitures des immeubles d'avant 1960 et des années 1960 ont été remplacées. Les plaintes exprimées dans 25% des immeubles d'avant 1960 et des années 1960 et dans 36% des immeubles d'après 1979 concernent généralement des toits qui coulent.

## INSTALLATIONS TECHNIQUES

Les systèmes de chauffage et de climatisation, l'aération, l'eau domestique, le drainage et la plomberie sont des systèmes dont la réparation suppose des coûts élevés à plus long terme, la moyenne par logement s'établissant à 717 dollars pour la période de 3 à 5 ans et à 1332 dollars pour la période de 6 à 10 ans. Au sujet des installations mécaniques, on se plaint généralement que la température est trop basse, que les soupapes ne ferment pas complètement et qu'on ne peut pas contrôler la température. Les plaintes au sujet des systèmes d'aération portent généralement sur l'humidité et les odeurs. Les plaintes au sujet de l'eau domestique touchent en général des fuites dans les conduits, une pression insuffisante dans les vieux immeubles et des soupapes qui ne ferment pas complètement. Les plaintes au sujet du drainage touchent le retour de l'eau de lessive dans les étages inférieurs et la formation de flaques d'eau dans le garage. Les plaintes au sujet de la plomberie touchent des appareils et des robinets qui coulent, des soupapes qui ne ferment pas complètement et le manque de contrôle sur la température.

### Chauffage Et Climatisation

Les travaux touchent typiquement le remplacement de conduits et de chaudières. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 2742 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 3550 dollars par logement. Les immeubles d'avant 1960 sont équipés de chaudières ayant 26 ans en moyenne; leur remplacement s'impose donc.

### VENTILATION

Les travaux touchent typiquement le remplacement des dispositifs d'air d'appoint. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 2526dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 3143 dollars par logement. Les corridors de presque la moitié des immeubles d'avant 1960 ne sont pas pressurisés, d'où le manque d'aération et les plaintes.

### Eau Domestique

Les travaux touchent typiquement le remplacement de conduits et de chauffe-eau. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 1804 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 2540 dollars par logement. Les immeubles sont équipés de chauffe-eau ayant entre 10 et 15 ans en moyenne; leur remplacement s'impose donc.

### Drainage – Égout Sanitaire Et Égout pluvial

Les travaux touchent typiquement le remplacement de conduits bouchés ou qui font défaut. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 290 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 563dollars par logement.

### Plomberie – Appareils Et Garnitures

Les travaux touchent typiquement le remplacement de garnitures et d'appareils trop vieux ou qui font défaut. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 1712 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 2278 dollars par logement. La majeure partie des appareils dans les immeubles d'avant 1960 et des années 1960 sont neufs. Les appareils des immeubles construits à partir de 1970 n'ont pas encore été remplacés en général.

## SYSTÈMES ÉLECTRIQUES

L'alimentation et la distribution électrique, l'éclairage et les installations auxiliaires sont des systèmes dont la réparation suppose des coûts élevés à plus long terme, la moyenne par logement s'établissant à 564 dollars pour la période de 6 à 10 ans. Les plaintes au sujet de l'alimentation électrique touchent généralement l'installation de fusibles de pouvoir de coupure trop élevé de même que le manque de capacité des panneaux électriques. Les plaintes au sujet de l'éclairage touchent généralement la faiblesse de l'éclairage à certains endroits et l'état général laissant à désirer. Les plaintes au sujet des installations auxiliaires touchent généralement le mauvais fonctionnement des systèmes d'entrée dans l'immeuble.

### Alimentation Et Distribution Électrique

Les travaux touchent typiquement l'amélioration générale du système. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 2917 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 5250 dollars par logement. Les plus vieux immeubles sont généralement équipés de systèmes surchargés, dont les fusibles ont un pouvoir de coupure trop élevé et qui n'ont pas de mise à la terre; leur remplacement s'impose donc.

### Éclairage

Dans la plupart des vieux immeubles, on a remplacé les appareils d'éclairage par des appareils éconergétiques; il ne reste donc qu'à en faire autant dans les immeubles où cela n'a pas encore été fait. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 199 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 549 dollars par logement.

### Installation auxiliaires

La réparation des systèmes téléphonique et de câblodistribution relève peu des propriétaires. La plupart des travaux les concernant touchent le remplacement des systèmes d'entrée dans les immeubles. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1970, soit 94 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 560 dollars par logement.

## SÉCURITÉ DES OCCUPANTS

Les systèmes de sécurité des occupants, d'extinction des incendies, d'alarme incendie, de communication interne et de courant de secours sont des systèmes dont la réparation suppose des coûts peu élevés à court terme, la moyenne par logement s'établissant à 38 dollars pour la période de 1 à 2 ans et à 3 à 7 dollars pour les autres périodes. Les systèmes d'extinction des incendies n'ont fait l'objet d'aucune plainte écrite. Les plaintes au sujet des alarmes incendie portent généralement sur les fausses alarmes et sur le manque de puissance sonore. Les plaintes au sujet des systèmes de courant d'urgence sont peu nombreuses, mais elles portent sur de l'éclairage trop éblouissant, des

génératrices qui ne démarrent pas ou des appareils qui ne sont pas branchés. En général, les systèmes ont été améliorés pour satisfaire la norme OR 627/92 du Code de prévention des incendies.

### Extinction Des Incendies

Dans la plupart des immeubles, les systèmes d'extinction des incendies ont été améliorés pour satisfaire la norme OR 627/92 du Code de prévention des incendies; il ne reste donc qu'à en faire autant dans les immeubles où cela n'a pas été encore fait. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 79 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 220 dollars par logement.

### Alarme Incendie Et Interphone

Dans la plupart des immeubles, les systèmes d'alarme incendie et d'Interphone ont été améliorés pour satisfaire la norme OR 627/92 du Code de prévention des incendies; il ne reste donc qu'à en faire autant dans les immeubles où cela n'a pas été encore fait ou qui ne renferment pas de tels systèmes. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles des années 1970, soit 114 dollars par logement, et le coût maximal touche un immeuble d'avant 1960, soit 786 dollars par logement.

### Courant De Secours

Dans la plupart des immeubles, les systèmes de courant de secours ont été améliorés. Ainsi, les travaux touchent typiquement le remplacement de batteries ou d'ampoules. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 105 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 507 dollars par logement.

## ASCENSEURS

Les ascenseurs, les unités de commandes de l'équipement et les systèmes de commandes des cabines et des portes sont des systèmes dont la réparation et l'entretien supposent des coûts élevés, la moyenne par logement s'établissant à 564 dollars pour la période de 3 à 5 ans et à 2 à 153 dollars pour les autres périodes. Les plaintes à leur sujet sont peu nombreuses, mais elles touchent, entre autres, des commandes de cabine qui ne fonctionnent pas, des cabines qui sont trop souvent hors d'usage et des ascenseurs dont le fonctionnement produit des secousses ou est brusque.

Les systèmes des ascenseurs sont régulièrement inspectés et entretenus; toutefois, leur amélioration n'a pas encore été faite dans la plupart des immeubles. Ainsi, les travaux touchent typiquement le remplacement de commandes et de pièces d'équipement, remplacement qui s'impose d'ailleurs. Le quartile à 75% dont les coûts sont les plus élevés concerne les immeubles d'avant 1960, soit 2115 dollars par logement, et le coût maximal touche un immeuble des années 1960, soit 3651 dollars par logement.

## RÉPARTITION DES COÛTS SELON L'ÂGE DES IMMEUBLE

### IMMEUBLES D'AVANT 1960

Pour les 10 prochaines années, ce sont les immeubles d'avant 1960 dont les réparations entraîneront les coûts les plus élevés par logement, depuis environ 4000 dollars pour le quartile à 25%, en passant par environ 17000 dollars pour celui à 75%, jusqu'à un maximum de plus de 21000 dollars. Ce groupe d'âge comprend les immeubles des années 1930, qui ont grand besoin de réparations dans plusieurs domaines.

### IMMEUBLES DES ANNÉES 1960

Pour les 10 prochaines années, les immeubles des années 1960 présentent le plus important coût global de réparation, car il s'agit du groupe d'âge le plus imposant. Les coûts des réparations par logement varient depuis environ 5000 dollars pour le quartile à 25%, en passant par environ 9500 dollars pour celui à 75%, jusqu'à un maximum de plus de 17500 dollars. Ce groupe d'âge comprend la majeure partie des immeubles.

### IMMEUBLES DES ANNÉES 1970

Les immeubles des années 1970 présentent à peu près les mêmes caractéristiques que les immeubles des années 1960, mais ils sont plus récents que ces derniers. Pour les 10 prochaines années, les coûts des réparations par logement varieront depuis environ 1500 dollars pour le quartile à 25%, en passant par environ 4500 dollars pour celui à 75%, jusqu'à un maximum de plus de 6000 dollars. Si ces travaux de rénovation ne sont pas exécutés, leurs coûts atteindront ceux des immeubles des années 1960.

### IMMEUBLES D'APRÈS 1979

Les immeubles d'après 1979 dans cet échantillon se composent principalement de logements sociaux, car la construction de logements locatifs privés a chuté radicalement à la suite de l'initiative de contrôle des loyers mise en oeuvre en 1975. Pour les 10 prochaines années, les coûts des réparations par logement varieront depuis environ 500 dollars pour le quartile à 25%, en passant par environ 3500 dollars pour celui à 75%, jusqu'à un maximum de plus de 7000 dollars.

## RÉPERCUSSIONS DES COÛTS SUR LES PROPRIÉTAIRES

Les coûts des réparations exposés dans la présente étude seront généralement recouvrés par les revenus de location. Nous avons effectués des calculs reposant sur un revenu brut mensuel moyen de 751 dollars pour les quartiles à 25%, 50% et 75% et pour les coûts maximaux. Si la plupart des sous-systèmes peuvent être réparés au cours des 10 prochaines années à un coût inférieur à 1% du revenu brut de ces 10 années, plusieurs systèmes entraînent des coûts supérieurs.

Le point de référence utilisé pour l'évaluation est le quartile à 75%, c'est-à-dire le niveau auquel la réparation des sous-systèmes de 75% des immeubles coûte moins de 1% du revenu brut. Dans le quartile à 75%, les sous-systèmes dont la réparation coûte au moins 1% du revenu brut ainsi que le coût de cette réparation exprimée en pourcentage du revenu brut sont les suivants :

- Les garages des immeubles des années 1960, pour 1% du revenu;
- Les fenêtres des immeubles des années 1960, pour 1,63% du revenu;
- Les systèmes de chauffage et de climatisation des immeubles d'avant 1960, pour 3,04% du revenu;
- Les systèmes d'aération des immeubles d'avant 1960, pour 2,80% du revenu;
- Les systèmes d'eau domestique dans les immeubles d'avant 1960, pour 2,0% du revenu;
- Les systèmes de plomberie des immeubles d'avant 1960, pour 1,9% du revenu;
- L'alimentation et la distribution électrique des immeubles d'avant 1960 et des années 1960, pour 3,24% et 1,67% du revenu, respectivement;
- Les ascenseurs des immeubles d'avant 1960 et des années 1960, pour 2,35% et 1,9% du revenu, respectivement.

Nous avons également réalisé une évaluation distincte des sept immeubles présentant les coûts les plus élevés. Les coûts globaux pour ces immeubles pour les 10 prochaines années oscillent entre 17,2% et 23,6% du revenu brut. Il ne fait aucun doute que les propriétaires de certains immeubles seront incapables d'effectuer les travaux de réparation sans connaître de graves difficultés financières ou sans une aide financière quelconque.

### Questions Touchant L'énergie

L'amélioration de l'efficacité énergétique de l'éclairage a été effectuée par la plupart des propriétaires des immeubles; toutefois, très peu d'autres améliorations ont été apportées, probablement en raison de la longueur excessive du délai de récupération et de l'absence de stimulants. En général, les propriétaires refusaient de fournir des renseignements, même qualitatifs, sur les économies ainsi réalisées.

## Utilisation des résultats et du protocole de sondage

La décision de faire appel à des experts pour la réalisation du sondage s'est avérée une manière très rentable d'obtenir des données sur l'état des immeubles et sur les coûts des réparations. La collecte des données à l'aide de formules de saisie de données a permis, de façon générale, l'adoption d'une méthode structurée d'enregistrement et de saisie des données dans une base de données. La saisie des données proprement dite devrait toutefois être confiée à des personnes qualifiées dans le domaine de l'évaluation des bâtiments, car les inconsistances et les notes explicatives ajoutées par les vérificateurs doivent parfois être interprétées.

Pour les prochaines études, nous prévoyons qu'un nombre important d'immeubles (25 ou plus) pourront faire l'objet du sondage et que la saisie des données et l'évaluation coûteront environ 5000 dollars par immeuble.

### Évaluation À L'aide Du Facteur De Notation

Un nouvel outil d'évaluation, le facteur de notation des bâtiments ou système de notation, a été appliqué à chaque sous-système. Le système de notation évalue le temps s'écoulant avant qu'une réparation ne soit effectuée et les répercussions d'une malfonction sur la sécurité et l'utilisation de l'immeuble. Les coûts ne sont pas pondérés dans le système de notation; toutefois, une pondération est appliquée à la sécurité et à l'utilisation de l'immeuble ou du système en cause.

L'évaluation des coûts de réparation par logement de tous les immeubles de l'échantillon produit un histogramme de répartition des fréquences qui est carrément désaxé vers la droite (coefficient d'asymétrie de 0,93), ce qui témoigne de la présence de plusieurs immeubles nécessitant des réparations onéreuses. L'histogramme des notes de l'ensemble des immeubles révèle une répartition symétrique, le coefficient d'asymétrie s'établissant à 0,01. Une symétrie parfaite produit un coefficient d'asymétrie de 0. L'aplatissement, ou tendance qu'ont les valeurs de se concentrer près de la valeur médiane, calculé pour les coûts des réparations par logement pour l'ensemble des immeubles s'établit à 0,63, il est de 0,65 pour l'ensemble des notes. Une courbe normale produit un aplatissement de 3. La répartition des données est donc quelque peu aplatie dans l'analyse des coûts des réparations par logement et dans l'analyse des notes. Cette réalité révèle qu'il y a une vaste gamme de coûts et de notes.

Les notes obtenu pour un système ou sous-système donné sont comparables entre les divers groupes d'âge des immeubles, mais elles ne le sont pas pour les divers systèmes d'un immeuble ou pour un immeuble par rapport à un autre.

La note moyenne de l'ensemble des immeubles de l'échantillon s'établit à 414. Les notes oscillent entre 98 et 721. Les immeubles du quartile supérieur, c'est-à-dire les plus détériorés, ont une note élevée qui approche 520 à 540.

### Utilisation Des Résultats

On peut utiliser les résultats de la présente étude pour produire des données de base sur l'état des immeubles et les coûts des réparations des immeubles dans la région de Toronto. Si le protocole utilisé pour l'étude était appliqué à un échantillon analogue dans 5 à 10 ans, les coûts des réparations par logement et les notes obtenus pourraient facilement être comparés à ceux obtenus dans la présente étude, ce qui fournirait un point de référence pour évaluer l'état du parc de logements.

On pourrait comparer les résultats de la présente étude à ceux d'études sur des immeubles dans d'autres centres urbains comportant de vastes parcs résidentiels de générations analogues, comme Vancouver, Montréal ou Ottawa. Cette comparaison pourrait nous renseigner sur les effets possibles de l'exposition environnementale, des types d'immeubles et, peut-être, des lois sur le contrôle des loyers.

On pourrait également utiliser les résultats de la présente étude pour extrapoler et déterminer ainsi les coûts des réparations de l'univers de l'échantillon et du parc de logements de mêmes types dans les quartiers environnants de Toronto et de York, là où l'étude a été menée. Une extrapolation du coût global des réparations des immeubles à Toronto et à York est présentée ci-après.

# Extrapolation des résultats

## Extrapolation Des Coûts Des Réparations Dans d'autres Centres Urbaines

Pour établir par extrapolation les données dans d'autres centres urbains, il faut que les caractéristiques des immeubles dans ces centres soient semblables ou identiques à celles des immeubles visés par la présente étude. Des erreurs dans l'établissement des coûts se glisseront si les immeubles ne sont pas de conception et de construction analogues.

De plus, on ne peut pas établir par extrapolation les données d'un groupe d'âge à partir d'un autre groupe d'âge, car il ressort de l'étude que l'âge des immeubles est la principale cause des coûts de réparation.

## Extrapolation Du Coûts Global Des Réparations À Toronto Et À York

Selon nos calculs, le coût global des réparations des immeubles à Toronto et à York pour les 10 prochaines années s'élève à 416 millions de dollars. Ce résultat a été calculé d'après le coût global des réparations des immeubles de chaque groupe d'âge pour les 10 prochaines années et d'après le nombre réel d'immeubles de l'univers de l'échantillon. Une simple extrapolation reposant sur le pourcentage de logements de l'échantillon par rapport à l'ensemble de logements dans l'univers de l'échantillon surestime les coûts en raison de l'influence exercée par un léger suréchantillonnage d'immeubles des années 1930.

La répartition des coûts globaux est la suivante :

| | | |
|---|---|---|
| **Immédiatement** | 14 775 000 $ | *Structure et sécurité des occupants, principalement* |
| **1 à 2 ans** | 105 687 000 $ | *Structure et enveloppe des bâtiments, principalement* |
| **3 à 5 ans** | 137 374 000 $ | *Installations techniques et ascenseurs, principalement* |
| **6 à 10 ans** | 157 897 000 $ | *Installations techniques et systèmes électriques, principalement* |
| **Total** | 415 733 000 $ | |

## Comparaison Avec D'autres Études

La valeur globale des travaux de réparation pour les 10 prochaines années est comparable à celle dérivée de l'Apartment Conservation Study de 1992 à l'aide de moyens moins sophistiqués et à celle dérivée de la Study of Residential Intensification and Rental Housing Conservation de 1984. Le coût des réparations prévu par l'Apartment Conservation Study s'établissait à 391 millions de dollars pour les 10 prochaines années dans l'ancienne ville de Toronto. Par une correction permettant d'inclure la ville de York, on obtient un coût de 457 millions de dollars de réparations pour les 10 prochaines années. Selon la Study of Residential Intensification and Rental Housing Conservation, le coût des réparations s'établissait à 10 000 dollars par logement pour les 20 prochaines années, soit environ 721 millions de dollars pour cet échantillon. Les 10 années additionnelles représentaient une hausse des coûts de 73%.

Les coûts établis dans la présente étude se fondent sur le sondage réel de 63 immeubles et sont considérés comme étant une prévision fiable des besoins réels en réparations.

# Preamble

# Preamble

## How to Read this Report

This report is provided in two volumes. Volume 1 is the discussion of the findings. Volume 2 includes Appendices to the discussion. While the reader can get a good appreciation of the findings by reading just the first volume, a thorough understanding of the findings will require that both volumes be reviewed simultaneously, as the text makes reference to the appendices on numerous occasions.

### VOLUME 1

Volume 1 is provided in six parts.

**Part 1** is the **Introduction** discussing the goals and objectives of the study, describing the participants in the study and the types of reporting provided to the owners.

**Part 2** describes **The Evaluation Protocol** and compares the protocol developed for this study with other types of evaluations commonly conducted and specific evaluation protocols employed by other major housing providers.

Part 2 also describes the seven assessment parameters used in the evaluation, each representing a primary building system: *Site, Structure, Building Envelope, Mechanical, Electrical, Life Safety* and *Elevator.* The 21 sub-systems within the seven broader building systems are also described. Part 2 presents the criteria employed in making the evaluation, describes the methodology involved and introduces a new assessment tool, the building or component "rating".

**Part 3** describes **The Building Sample,** the sample universe and how the sample was obtained.

**Part 4 is** the **Overall Sample Analysis** and includes a description of the general characteristics of the sample, the means by which the data is interpreted, and a description of the general characteristics of the sample population. The bulk of Part 4 consists of seven sections, each representing one of the major systems. In each of the seven sections, the subsystems are discussed in terms of typology, issues raised by tenants and staff, ongoing repairs, and the costs/unit and ratings.

**Part 5** provides **General Observations** of the findings, beginning with some general comments on the costs and ratings, energy issues, and the impact of the costs on owners of buildings.

**Part 6** discusses **Using the Results and the Protocol** and gives recommendations on the sample and the process, extending the results to the building universe and to other areas.

## VOLUME 2

The Appendices included in Volume 2 provide the data and the charts summarized from the database.

**Appendix A** provides **Building Universe and Sample** Data on the sample and the raw data on the buildings.

**Appendix B** provides a copy of the **Survey Protocol** used by the building auditors.

**Appendix C** provides a copy of the **Building Typology Data** detailing the as-found design and construction details.

**Appendix D** provides the **Costs and Ratings Summaries** in graphical form for each building system and subsystem for the various age groupings of buildings and over the 10-year period.

**Appendix E** provides the **Costs and Ratings Histograms** showing the distribution of costs/unit over the next 10 years for each building subsystem.

**Appendix F** reviews the **High Cost Buildings** in detail describing the rationale for the higher costs for those buildings.

**Appendix G** reviews the **Energy Conservation Measures** undertaken and in the sample buildings.

# Part 1 Introduction

# Part 1 Introduction

## Goals and Objectives

The study was completed in two phases and provided two deliverables expected to be useful for future building evaluation and repair assessment. Phase I was the development of a survey instrument suitable for the assessment of high-rise rental housing condition and costs for repair. Phase II was the actual survey of buildings and the analysis of the findings.

The objective of the Phase II survey of buildings was to determine actual on site data on a statistically relevant sampling of buildings. A unique form of survey was needed to permit a relatively large sampling of buildings at a reasonably low cost per building. The survey protocol developed in Phase I allows easy recording of the data by suitably skilled people. The database structure employed to analyze the data is based on Microsoft Access and can be refined as needed to permit specific assessments.

The primary output is a survey of 63 high-rise buildings, in the Cities of Toronto and York, providing comprehensive building condition and repair data. The survey results are available for analysis; however, the actual building addresses and ownership was maintained in confidence. The results of the study are presented in this report. A separate database is provided, including the building data, but excluding address and ownership details.

The study was initiated out of a need to better understand the condition of the high-rise rental housing stock and, thus, to be able to better come to grips with the needs of the buildings in order to sustain the stock into the future. While it is known that the majority of the existing high-rise rental stock in the Toronto area is in the order of 30 years old, reliable information on building condition, costs and repair needs are not well documented in a readily retrievable form. The study structure thus developed to meet the following goals.

- There is limited statistical information on the physical condition of high-rise buildings. Anecdotal cost and case studies provide inadequate information on predictability of repairs and costs for buildings as these tend to look only at the problems and not at general condition. A more random sampling is required. A goal of the study was to sample the buildings in Central Toronto and determine costs for repair and condition of the buildings on the basis of a more **reasonable cross-section of the building population.**
- Research completed in 1992 (City of Toronto High Rise Apartment Conservation study)[(1)] provided a proposed program of bringing existing buildings up to a condition with no deferred maintenance and then maintaining the stock in that condition; however, the costs for that program were based on estimated average values for repair for buildings of different vintages. Three other goals of this study are to improve on the cost and condition information by providing: 1) condition and cost data on a **large sample** of buildings; 2) **costs over a ten year period**; and 3) a range and **frequency distribution of costs** for buildings, different building systems and different repair periods in the future.
- There is a need to know what aspects of the high-rise housing stock require development of cost effective repair strategies. Canada Mortgage and Housing Corporation (CMHC), with guidance from the National High-Rise Committee, is looking to ways to make the overall cost of building ownership less costly through the life of the building. As one of the projects being sponsored by CMHC, a goal of this study is to provide data on the condition of buildings that will **facilitate the direction of research appropriate to building repair strategies.**

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*(1) Apartment Conservation Study, 1992, by Hemson Consulting, Morrison Hershfield Limited and Fraser & Beatty.*

# Participants

Canada Mortgage and Housing Corporation, the (previous) City of Toronto and the (previous) City of York funded the study to obtain an analysis of condition data on actual buildings. The study was supported and guided through a steering committee consisting of representatives from several departments in the City of Toronto, the City of York, Canada Mortgage and Housing Corporation, the Ontario Ministry of Municipal Affairs and Housing, and the Fair Rental Policy Organization of Ontario.

Liaison with the rental community was considered to be critical to the success of the assignment and proved to be very useful in promoting the study objectives and preparing the rental community for the survey itself. The participation of the Fair Rental Policy Organization of Ontario in this regard was instrumental not only in accessing buildings but also in the expansion of the scope of the study to include social housing stock as well as private rental stock.

The study consultant's team consisted of the following companies.

| Function | Team Member | Responsibilities |
|---|---|---|
| Project Manager | Gerald R. Genge Building Consultants Inc | Phase I: Research and survey protocol development, development of terms of reference for Phase II consultants.<br>Phase II: Survey sample, development of database, analysis of results, preparation of report and findings. |
| Building Consultants Review | Brook Van Dalen & Associates | Phase II: Site, Structure and Building Envelope Survey. |
| | Thomas A. Fekete Ltd. | Phase II: Mechanical, Electrical and Life Safety Survey. |
| | KJA Consultants Inc. | Phase II: Elevator Survey. |

Separate contracts were provided for the Phase I and Phase II consultants. The Phase I consultant was excluded from the actual on site surveys.

# Reports

In addition to and separate from this report, is a summary report prepared for each building owner giving the costs for repair of their building.

# Part 2 The Evaluation Protocol

# Part 2 The Evaluation Protocol

## Types of Building Evaluation

There are two broad categories of audits or evaluations for existing high-rise buildings, the "Typical Building Audit" and the "Expert Buildings Audit", as discussed below.

### TYPICAL BUILDING AUDITS

The "typical" building audit is generally performed by professionals skilled in one or more technical fields. The team of experts, within their specialty, make an educated assessment of the need for and the scope of repair for the relevant building components and systems, considering the impact of design, age, use, maintenance, mechanisms of deterioration, alternative remedial measures, costs and inconvenience. In some instances, less experienced staff record their observations for later interpretation and assessment by more experienced staff. These types of building audits generate a thorough review of the design, as-found conditions, and often, a deficiency list in the final report.

Frequently, with respect to high-rise residential properties, a potential purchaser or a new owner commissions these building audits. The results of more comprehensive building audits may lead directly to the specification of repairs; or, they may lead to the recommendation for more detailed assessments of specific concerns that require further exploration before repairs can be accurately described for the purposes of obtaining bids.

While the overall thrust of the surveys is common among consultants, there is no established protocol for performing this type of building survey. Each consultant takes a different approach and reports findings using a different format. The cost of such building audits can range from several thousand to several tens of thousands of dollars depending on the depth of the evaluation, the complexity of the buildings and the experience of the consultants.

### EXPERT BUILDING AUDITS

Like the "typical" building audit, the "expert" building audit uses a team of skilled professionals. Unlike the 'typical' audit though, the 'expert' audit generally does not go into the depth of review, survey of quantities or development of deficiency reports, as would the detailed audit.

Also, unlike the detailed audit which may make use of less experienced staff to gather data about the condition of the building, the 'expert' audit requires "hands-on" site evaluation by skilled professionals as they are more likely to possess the technical maturity and insight to determine if existing conditions are acceptable or problematic.

The "expert" evaluations are based on the technical maturity of the experts. As the experts are expected to be alert to the signs of distress, the relevance of those signs and the costs for effective and efficient repair, they were not required to engage in detailed quantity surveys or in the detailed review of drawings to assess the nature and value of the needed repairs. In these situations, it is vital that the highest level of technical expertise available be engaged to make the assessment to avoid omission or inefficiencies that could result from the use of less experienced staff.

The "expert" building audit was used for the condition survey of the high-rise rental stock in the Cities of Toronto and York. We anticipate that the project will have achieved economic benefit by having only the highest levels of technical expertise involved. The acknowledgement that the audit is of a cursory nature does not mean that the audit is somehow incomplete. The complete building is reviewed within the limitations of the assessment parameters. The cursory building audit is simply performed in less detail and at less cost.

# Assessment Parameters

## PHYSICAL PARAMETERS

The buildings selected for the study were assessed under the following seven physical parameters:

1. Site
2. Building Structure
3. Building Envelope
4. Mechanical
5. Electrical
6. Life Safety
7. Elevators

Interior Finishes were excluded from the evaluation protocol as the objective of the assessment was to determine the requirement for capital expenditures. Most often, finishes are renewed within apartment units on turnover or after several years for long-term tenants.

Also excluded was any assessment of the Function or Spatial considerations. No assessment was made concerning barrier-free access or whether the property is meeting the owner's needs for best use of the space or property.

## PLANNING PARAMETERS

Ongoing repair needs are of continual concern for owners and managers for buildings. These needs may not be part of a planned capital expenditure program as it is only recently that long-term planning has been identified within the perspective of how deterioration affects the life cycle of building materials and systems. For instance, most building owners know that they will have to replace a boiler or a roof; however, until recently, it has not been anticipated that the concrete of balconies or the garage roof waterproofing would require substantial expenditures.

Treated individually, the building materials and systems could be handled by independent investigation of the existing conditions and identification of repair or replacement needs and costs. This approach, however, usually only reacts to the immediate repair needs. The identification of capital expenditure needs for the future is also of interest, both in terms of short-term, foreseen capital expenditures that can be deferred, and in terms of those that are not presently in evidence but can be anticipated.

Our planning horizon considered that the age of the bulk of the existing housing stock is 30 to 35 years. In this regard, a plan for the next 20 or more years would seem to be excessively long as the building would have reached its anticipated life and major repair and replacement would seem to be unwarranted at the end of a building's planned life. Also, since our objective was not to schedule the repairs but to determine the overall repair needs, we determined that specific repair needs over a 20-year period would be inconsistent with the level of accuracy of the study.

We selected a 10-year horizon for the repairs. This time frame would allow a reasonable prediction of the expected repairs and replacement considering the existing condition of the buildings while not being unduly influenced by the normal building component replacement.

For costing purposes, the 10-year time frame was split into "Immediate", "1 to 2 Years", "3 to 5 Years", and "6 to 10 Years" to give the auditors a common frame of reference.

### Other Facility Planning Models

The owners of large portfolios have recently been undertaking audits of their properties to determine their long-term repair needs. Both private and public owners have been addressing cash flow and planning for repair and replacement.

The condominium reserve fund, for instance, typically provides an engineered evaluation of conditions and a cash flow plan for capital repair and replacement over the next 20 to 25 years. Such plans require ongoing updating both in terms of the repair/replacement time frame, the costs and the items included in the plan because building conditions, management practices, and repair/replacement strategies and costs change over time. While there were no condominium buildings included in this study, the study protocol could be used by reserve fund consultants to both document the nature of the construction and inventory the equipment, and to provide costs for repair and replacement of non-aesthetic or non-discretionary items. One of the characteristic dilemmas faced by reserve fund consultants is the absence of good records and drawings describing the nature of the construction. Further, the typical reserve fund study applies emphasis to the damage to be repaired and the costs for capital work but often the description of the building is incomplete. If completed with an initial reserve fund study, when drawings and the construction history are available, the more detailed record of the physical building systems may be helpful to future reserve fund consultants.

Metropolitan Toronto Housing Company Limited (MTHCL) has undertaken detailed audits, including 25-year plans giving detailed expenditures over the first 10 years and in 5-year groupings over the next 15 years. The MTHCL model provides a reasonable basis for cash-flow and planning over the first 10 years; however, the information over the subsequent 15 years could be used only for general long-term budgeting and not for specific repair and replacement planning. The audit structure employed is very detailed and costly (4 to 5 times the per-building cost for the protocol used in this study). While the objectives are similar, the level of detail sought by MTHCL in the definition of the repair is far greater than could be recorded by the non-destructive assessment methods employed by this protocol. The MTHCL studies are conducted by a variety of consultants and reports an lengthy and text oriented. The protocol used for this study would be useful as a common means for recording data allowing the survey consultant to focus on tabular costing assessments.

The Ontario Housing Corporation (OHC) has recently undertaken an extensive evaluation aimed at development of a detailed five-year plan and a five to ten-year cost for repair on a sample of ten percent of their portfolio. This model is similar to our methodology in that a 10-year planning horizon is selected and the specific accuracy of the plan is indistinct in the later years. The protocol employed by OHC is a standard format and is set up for use in a database. The similarities between the OHC format and this protocol confirm the value of the structured approach to building condition assessment and costing for repairs; however, the protocols are not readily interchangeable as the database structures differ.

## Assessment Criteria

The primary criteria used to assess the condition of the buildings included conformance with the City of Toronto Property Standards By-Law, conditions affecting public safety, and evidence of material deterioration. In addition, the normal life-cycle of the building elements was considered; thus, materials and systems that are currently in satisfactory condition would be expected to be identified as needing repairs in the 10-year capital cost horizon due to expected material deterioration.

There is some overlap between these criteria. The evaluation of the building repair needs focussed largely on material deterioration; however, where such deterioration created conditions that would affect the safety of the public, the issue flagged and a high priority for repair was identified.

## Conformance With Property Standards By-Law

While no direct comparison was made with the specific sections of the Property Standards By-Law *(Municipal Code Chapter 210, Housing Standards)*, the evidence of material deterioration itself would result in an identified need for repair that could be cited under the by-law. For instance, the property standards by-law requires that balconies, garages and exposed walls, as parts of the structure, be maintained in a sound condition. The intent of the survey was not to prepare a list of by-law infractions but to determine the repair needs and costs applicable to high-rise building.

## Conditions Affecting Public Safety

Conditions that were deemed by the auditor to present an imminent danger to the safety of the public were to be flagged and immediately brought to the attention of the building owner or manager. The owner/manager was expected to respond to the "dangerous" condition in one of the following ways.

1. Repair the condition so as to eliminate the threat to public safety.
2. Provide a report from a qualified professional that investigates the dangerous condition in sufficient detail that allows the condition to be declared safe.

No such conditions were noted during the Study. If such conditions were observed, and the property manager did not take the required action, the City of Toronto would have been notified of the address of a property. It would then become the responsibility of the City to take necessary measures to discharge the concern.

## Evidence Of Material Deterioration

Material deterioration can occur as a result of two conditions. All building materials age and show signs of distress or deterioration. This deterioration is generally not significant and often does not lead to repair. However, if the building is indicating its age in this manner and funds and motivation exist, rehabilitation or renovation may occur to deal with the age-related deterioration. Typical examples include interior finishes, flooring and cabinetry. This type of deterioration is largely related to aesthetics and is not included in the evaluation protocol.

The type of deterioration that is of concern in this study is that due to a specific cause or combination of causes that result in anomalous deterioration. Examples include the deterioration of parking garage and balcony concrete resulting from corrosion-induced spalling, or the spalling and efflorescence of brick around windows due to window or perimeter seal failure or at the tops of buildings due to exfiltration and rain water penetration. These types of cause-related deterioration can result in a serious building failure or are wasteful of energy and are considered in the protocol. Generally, the protocol does not determine that a repair is required solely to save energy. If energy use improvement upgrades are available as a matter of course at the same or modest increase in cost and a repair or replacement is required for durability reasons, the energy efficient replacement would be the reasonable option.

## Design Life And Service Life

Normal wear and tear and use of building systems results in deterioration in performance and deterioration in condition that cannot be economically corrected by normal maintenance. Typical examples would be the replacement of elevator controllers, heating boilers or make-up air units. Such system components are often replaced before they completely fail because building operation would be unduly affected if a failure occurred. The design life of the component may never be realized because it is taken out of service before failure. There is a similar service life for building components that are intended to last the life of the buildings. Typical examples include balcony slabs and parking garages, which require initial repairs and, usually, follow-up or ongoing repairs on a periodic basis.

The "service" life-cycle period differs for each building component. The expert auditor predicts the service life of the building component based on the condition of the element, considering maintenance, age and exposure, and the demands placed on the element, considering service loads and cycling, redundancy and the effects of failure, deterioration or wear processes involved, and experience with similar components and systems.

For the benefit of future auditors, CSA S478-95 "Guideline on Durability in Buildings" provides assistance in the prediction of service life; however, the published design life in the guideline is given in 5-year increments and involves broad ranges in life span. It is further limited by excluding mechanical and electrical components. Since the estimate of remaining service life is dependent on the expertise of the auditor and the existing conditions in each building, it is not particularly useful to future auditors for this report to set out a standard design life for the buildings elements considered. Still, it is generally considered that building components will last for a certain period, on average, and considering that reasonable and prudent maintenance is conducted. A summary of design life and typical service life prior to a major repair or replacement follows.

**APPROXIMATE DESIGN AND PRE-REPAIR SERVICE LIFE**

| System | Subsystem | Total Design Life to Replacement (yrs) | Pre-Repair Service Life (yrs) | Comments On Repair Needs[1] |
|---|---|---|---|---|
| Site | Pavement and Walks | 30-40 | 15-20 | Pavement overlay and partial replacement |
| | Site Structures | 30-50 | 20-25 | Retaining wall and fence replacement |
| Structure | Garage | 50 | 10-15 | Slab repair and waterproofing |
| | Balconies | 50 | 20-30 | Slab repair and guard replacement |
| | Building Framing | 50-100 | 20-30 | Exposed concrete repair |
| Building Envelope | Exterior Walls | 50 | 20-30 | Masonry repair and resealing<br>Recaulk precast |
| | Windows | 30-35 | 15-20 | Reseal, reweatherstrip, paint metal |
| | Exterior Doors | 30-35 | 15-20 | Reseal, reweatherstrip |
| | Roofs | 20-30 | 15-20 | Perimeter and penetration repair and resealing |
| Mechanical | Heating and Cooling | 20-25 | 15-20 | Boiler rebuild and valve replacement |
| | Ventilation | 20-25 | 15-20 | Replace fan motors and heaters |
| | Domestic Water Systems | 25-35 | 15-20 | Rebuild boilers, valves, pumps and isolated pipe |
| | Drainage | 30-50 | 15-20 | Replace sanitary/storm pumps and lateral pipe |
| | Plumbing | 30-50 | 15-25 | Replace valves and trim and isolated pipe |
| Electrical | Power Supply & Distribution | 30-50 | 15-25 | Replace distribution panels, splitters and suite panels |
| | Lighting | 30-50 | 15-20 | Replace fixtures |
| | Auxiliary Systems | 20-50 | 10-15 | Replace building entry system |
| Life Safety | Fire Suppression | 30-50 | 10-15 | Replace nozzles, hoses, sprinkler heads |
| | Fire Alarm & Voice Communication | 20-25 | 10-15 | Replace/upgrade sensors, alarm and voice system components |
| | Emergency Power | 30-50 | 10-15 | Replace starter/block heater |
| Elevators | Equipment | 30-50 | 20-25 | Replace/modernize, upgrade to code |
| | Cars | 20-25 | 10-25 | Modernize cars |

(1) Examples of work typically required prior to expiry of the design life.

The table above indicates that the typical design life exceeds the expected service life by a factor of two or more in most cases. It also indicates a period of between 10 and *25* years before a major repair can be expected. Since the majority of the buildings in the study were constructed in the 1960s and 1970s, a large percentage of the building population has reached an age where major repair or replacements are due. Unlike replacement of finishes, these replacements are not discretionary and, thus, have been included in the study protocol.

# Assessment Methodology

The assessment methodology was designed such that it could be used on a regular basis at the lowest cost that will produce reliable data. In this regard, it was determined that it would not be cost-effective to perform material sampling or destructive testing of the building components. Instead, the methodology relied upon the technical expertise of the assessment specialists. This approach minimized data gathering and maximized information gathering. Thus, only simple, quickly completed indicators are part of the assessment methodology.

The assessment takes place in five steps. These are:

1. The Interview,
2. Drawing Review (where available),
3. Building Inspection and Assessment,
4. Work Description and Cost Assessment,
5. Report to the Participants

## The Interview

One or more individuals that have prior knowledge of the building history or maintenance were interviewed either in person or by telephone. At that time, the seven physical systems were explored to help the evaluating specialist focus on known problem areas. In addition, information concerning the nature of previous repairs and routine maintenance of equipment was sought. Information concerning any significant changes to the building since construction was also sought. We found that information about previous repairs, maintenance practices, energy use, and proposed repairs was not always known or was not disclosed, perhaps considered to be confidential. As such, some of the information gathered is based on the opinion of the auditors.

## Drawing Review

If available, the design or record drawings of the building and systems were reviewed at the auditor's discretion. The depth of the review was intended to provide the evaluating specialist with building component and system characteristics, loads, design data, etc., that would assist them in determining the need for repair or replacement. It was not intended that a comprehensive code compliance assessment be conducted or that the drawings be critiqued in any manner. Drawings were made available for review on 7 of the buildings, including 5 social housing and 2 private rental buildings. These buildings were of more recent construction. This is not uncommon. Older buildings tend to not have drawings available or the drawings are only partial sets in poor condition. As a result, most building evaluations relied on the expertise of the auditor.

## Building Inspection And Assessment

Inspection and assessment of the building were linked as a function to be performed simultaneously by the experts reviewing the building. The inspection and assessment was conducted under each of the seven physical parameters, Site, Building Structure, Building Envelope, Mechanical, Electrical, Life Safety, and Elevators. Within each heading, the auditor completed a Building Condition and Rating Checklist that mirrored the analysis database input form. The database was structured to allow assessment of physical condition, repair costs, time frame for repairs, and building system typology. A complete copy of these checklists, or the Survey Protocol, can be found in Appendix B.

To augment the information obtained in the interview process and the observations made by the auditors, Forms 0-1 "Building Data", 0-2 "Maintenance and Repair of the Building" and 0-3 Energy Conservation Measures (pages B2-B14) were distributed to each building owner to be completed and returned. Fewer than 10% of the owners actually completed and returned the forms, preferring to provide information through the interview process while the auditor was on site.

### Work Description And Cost Assessment

On the basis of the "Expert Building Audit", a cost for repair or replacement was determined and entered on the survey forms. The cost was not reported with alternatives and did not consider cash flow appropriate for any particular owner, but was the best judgment of the auditor of the most cost-effective strategy to deal with repair or replacement over the next 10 years.

Some building components will have either a shorter or a longer life cycle than 10 years. The auditors were directed to consider the specific circumstances, such as the adequacy of maintenance, service loads applied, impact of a failure on the use of the element or building, or system redundancy, when making the assessment of the most cost-effective repair strategy and to select the most appropriate repair methodology.

### Report To The Participants

In addition to this report, a report on the building evaluation, focussing on the costs for repair and the building rating in comparison to other buildings in the study, was provided to each participant. Those reports maintained the confidentiality of the survey citing the building address on the cover sheet with the assigned building number. The participant report showed costs for repair in tabular form, together with a brief description for each repair item identifying the work required and the time frame. The participant reports included histograms to show the distribution of the sample population for all sub-systems. In this way the participant could determine how their costs compare to other building owners and how their building ranked in relation to the urgency for repair.

## Building Rating System

Each building component assessed was given a rating to assess the urgency of the repair in terms of timing and the safety/usability implication of a failure. The following chart describes the rating system.

**Building Rating System**

| Time Frame | Safety/Usability |
|---|---|
| 10 Immediate repair/maintenance required | 10 Building unsafe or unusable if failure occurs |
| 7 Repair/replace in the next 1 to 2 years | 7 Portions of the building unsafe or unusable if failure occurs |
| 5 Repair/replace in the next 3 to 5 years | 5 Potentially unsafe or unusable if general failure occurs |
| 3 Repair/replace in the next 6 to 10 years | 3 Minor potential safety hazard or loss of use risk |
| 0 Repair/replace not needed in the next 10 years | 0 No safety or usability risk |

The rating system was applied by the auditors. During analysis of the results, a weighting factor of 2 was applied to the *Safety/Usability* rating and the sum of the two rating numbers including the weighting factor was calculated.

For example, if a building component had a time-frame factor of 7 meaning that repairs should be performed in the next 1 to 2 years and a safety/usability factor of 5, the rating for the element would be $7 + (2 \times 5) = 17$. All individual ratings so calculated were summed to provide a total rating for the building. The ratings for each of the 21 subsystems for all 63 buildings in the study is presented as histograms in Appendix E.

# Part 3 The Building Sample

# Part 3 The Building Sample

## Sorting and Selection Criteria

### History Of High-Rise Building Construction

Map 1 on the following page depicts the construction of high-rise buildings in the City of Toronto and City of York since the 1930s. The two pie charts at the right side of the map illustrate the apartment distribution, both by buildings constructed and by apartment units constructed. There is very little difference in the number of units and in the number of buildings in each of the seven areas ascribed boundaries for the purposes of this study.

While a relatively small area, the largest population of units, at 28% of the total, is in the south central area, roughly bounded by Lake Ontario on the south, Bloor Street on the north, Bathurst Street on the west and the Don River on the East. The north central area, following the Don River and Bathurst Street boundaries up to Eglinton Avenue, has the second highest population of buildings in Toronto at 18%. York, to the west, also has 18% of the population of units in the sample. The area west of Bathurst, south of York and east of the Humber River has 11% of the sample population and the area east of the Don River to Victoria Park Avenue, generally south of Danforth Avenue, has 7% of the units. Finally, a relatively small area north of Eglinton set into the former City of North York has 10% of the population.

The distribution of buildings by decade form the 1930s to the 1990s is shown on Map 1. It is immediately apparent that the buildings constructed prior to the 1960s amount to roughly 10% to 15% of the total population of units. As such, and considering that these buildings were generally of a similar construction style, the units in the pre-1960s buildings were grouped as a single age grouping.

It is also immediately apparent that the 1960s construction period generated more rental units than any other decade, ranging from 34% to 50% of the population. This decade was chosen as a single building age group. Similarly, the 1970s period created a large number of units, generally ranging from 28% to 35%, but with the north west area as low as 19% and the north area as low as 7%.

Finally, the 1980s and the 1990s construction period (to 1995, which was the extent of the data available) generated 6% to 27% of the rental units and was selected as the fourth age group.

It is noted that condominium apartments, which grew in substantial number from the early 1970s, are omitted from this study as these buildings are legislated to perform building repairs through the Condominium Act of Ontario.

It is also noted in the column chart on Map I that social housing apartment construction increased in the 1970s as private rental apartment construction decreased. Social rental unit construction dropped off again in the 1980s and 1990s. No decade of construction, including social, private or combined social and private, has contributed as many rental units as the 1960s. These units still form the bulk of the affordable rental accommodation in the Toronto area.

## PRELIMINARY SCREENING

Building data reviewed from the (previous) City of Toronto and from the (previous) City of York provided the sample universe. The selection of the sample from this universe was completed by sorting and discarding building addresses with incomplete or obviously erroneous data. In addition, buildings with recorded construction dates prior to 1930 were discarded from the sample as many contained questionable data. Finally, buildings that are condominium residences, mixed use properties, nursing homes or dormitories were eliminated from the sample universe. The resulting population of buildings was reduced to 546 properties. This included 417 private rental buildings and 129 social housing buildings.

Table A-1 in Appendix A (pages Al-A10) shows a compilation of the raw data, stripped of addresses but including salient information on the type of building (private or social), year of registration, number of units, number of stories above grade and below grade and some information on the parking. The distribution of the building universe is shown on Chart A-1 on the following page. Chart A-1 can also be found in Appendix A (page A-11). The graphs included in Chart A-1 summarize the history of rental construction in Toronto and York for the selected sample universe by building and by apartment unit over the past 7 decades. The table included in Chart A-1 also shows the average number of stories above and below grade and the number of parking stalls above and below grade.

## SORTING PARAMETERS

The selection of the buildings is based on the age, location and ownership/management type. Buildings sampled for the study attempted to mimic the distribution of properties within the sample universe.

## AGE

The age of the building has been recognized as a guide to the building typology relevant to the seven building systems. The age of the building is derived from the year listed in municipal records. This was accomplished with reasonable success.

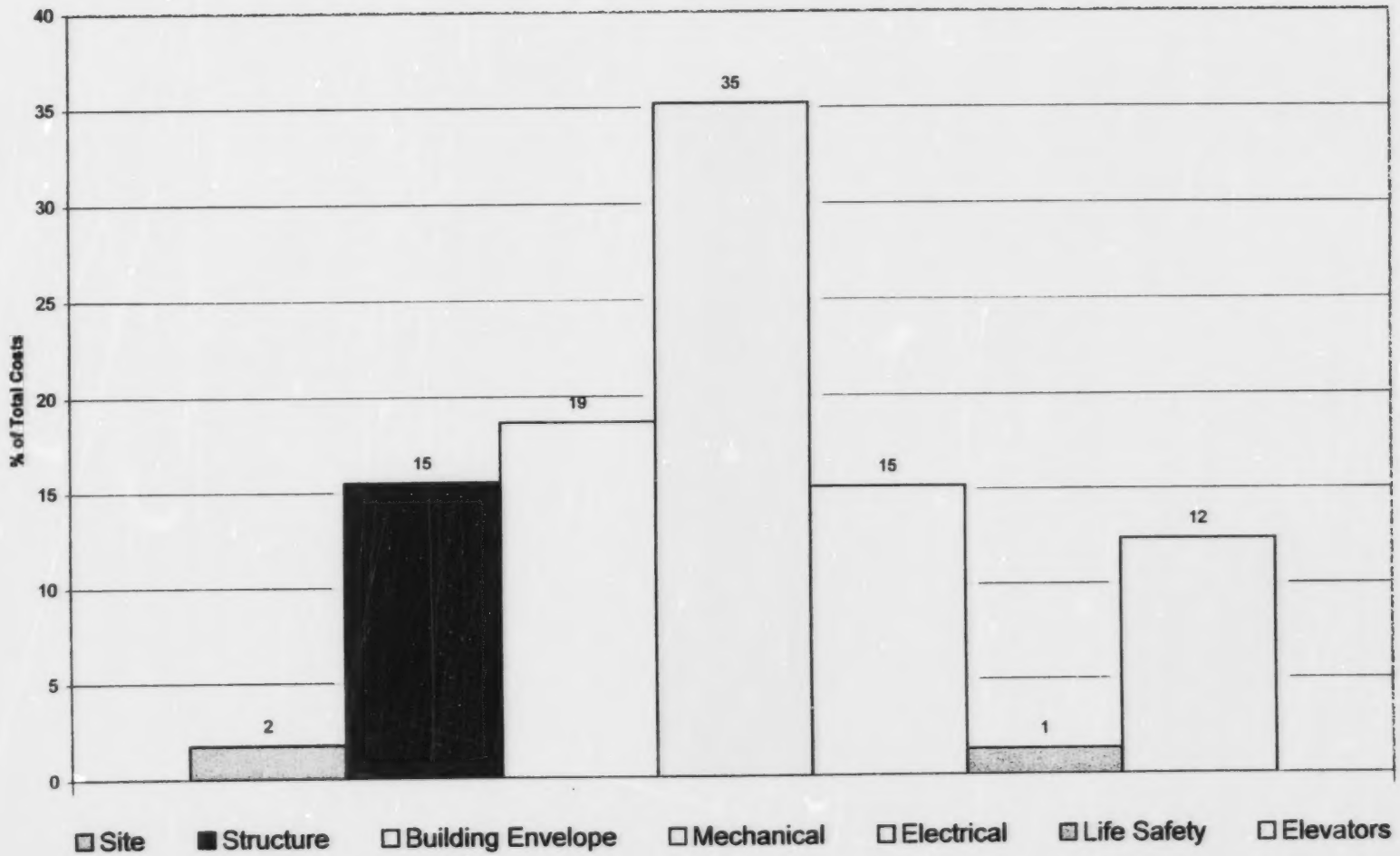
## LOCATION

The location of the property was considered as a potential factor that could impact on the condition of the building. In addition, the location of the property can affect some physical characteristics such as levels and type of parking. Selection by location was intended to provide a reasonable geographic representation of the sample population in keeping with the distribution of the sample universe. Selection using location was not intended to prejudice the outcome of the study by selecting buildings known to have problems. Selection on the basis of location within Toronto and York was found to be difficult and is concluded to be unreliable as an evaluation parameter.

## OWNERSHIP/MANAGEMENT TYPE

Where possible, a cross-section of ownership type was attempted. In this regard, the impact of single-building owners, multiple-building owners, public housing owners and private housing owners on the condition of the building could be assessed. This was accomplished only to the extent that social and private buildings were selected on the basis of the proportion in the sample universe.

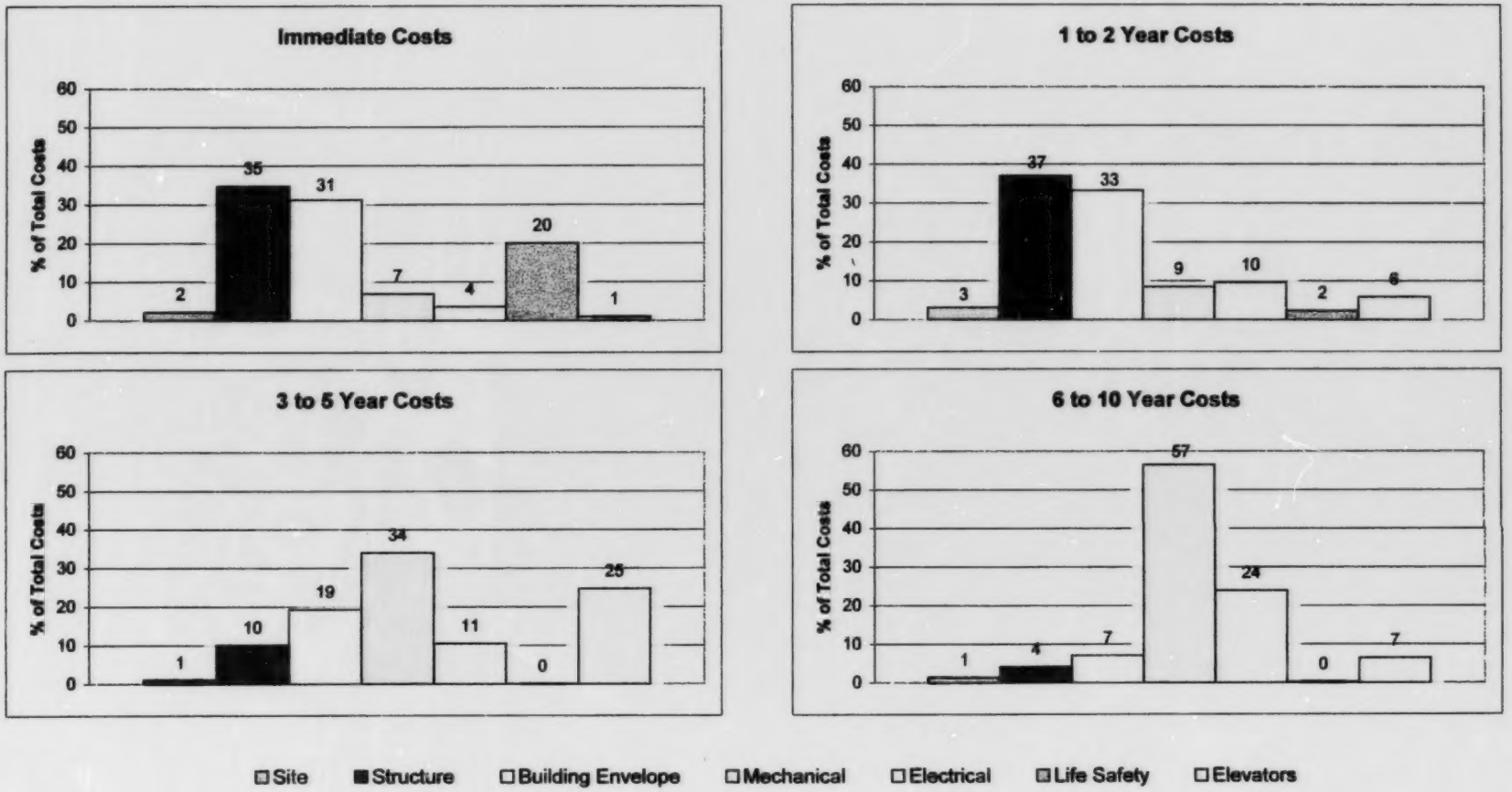
## Chart D-2. Percentage of Total Costs by Building System
## All Buildings, All Time Frames



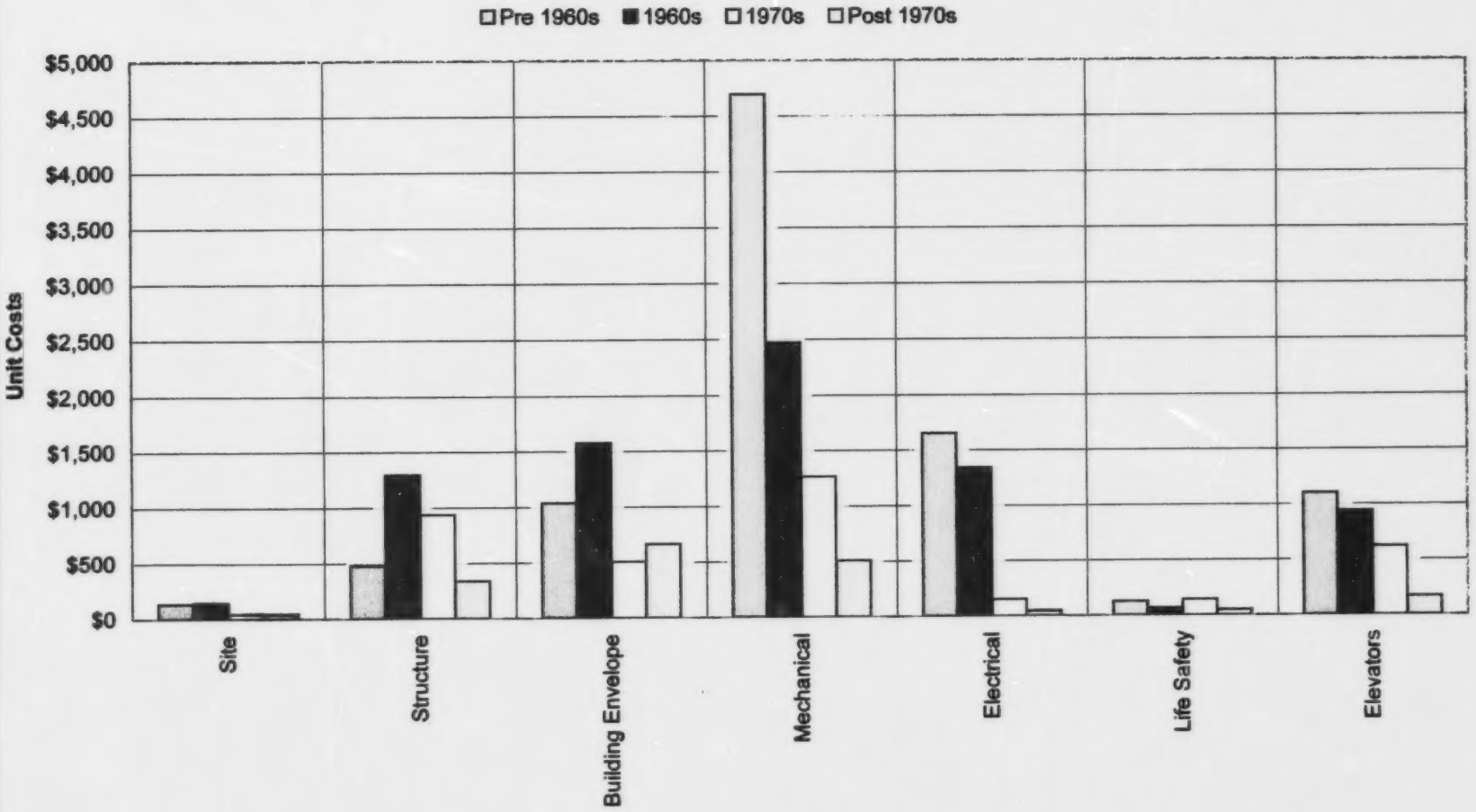



Percent Costs by Building System - Total Chart 16

## Chart D-3. Percentage of Total Costs, All Buildings, by Building System and Time Frame



## Chart D-4. Relative Comparison of Unit Costs by System and Age Group

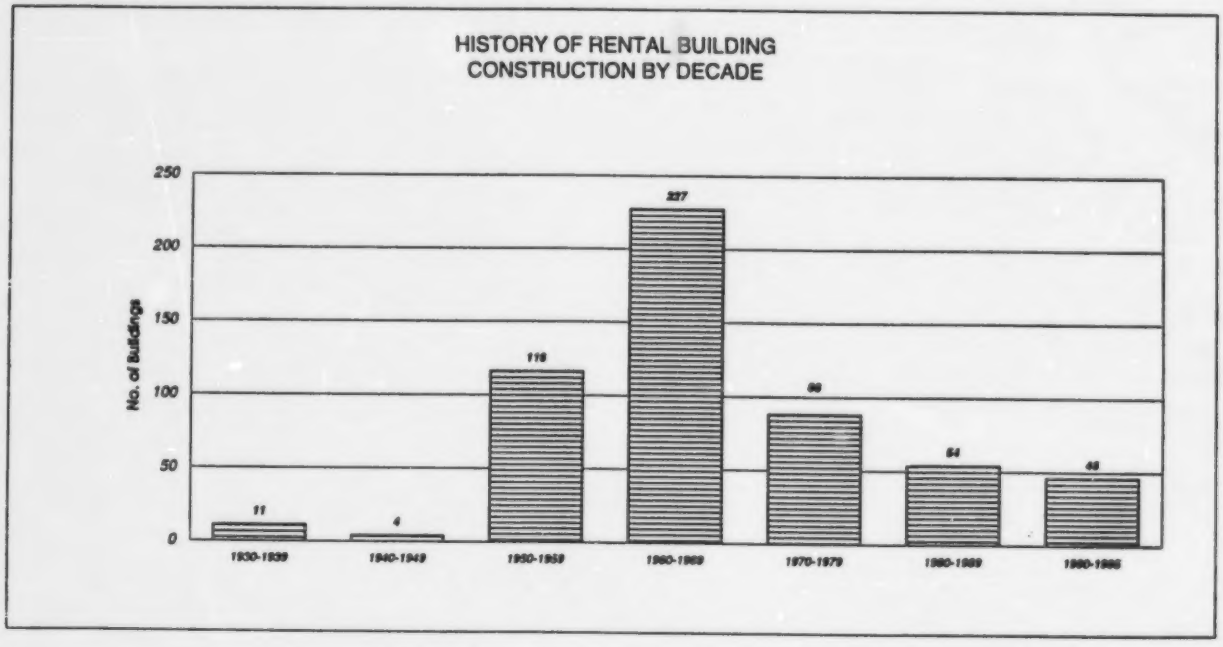


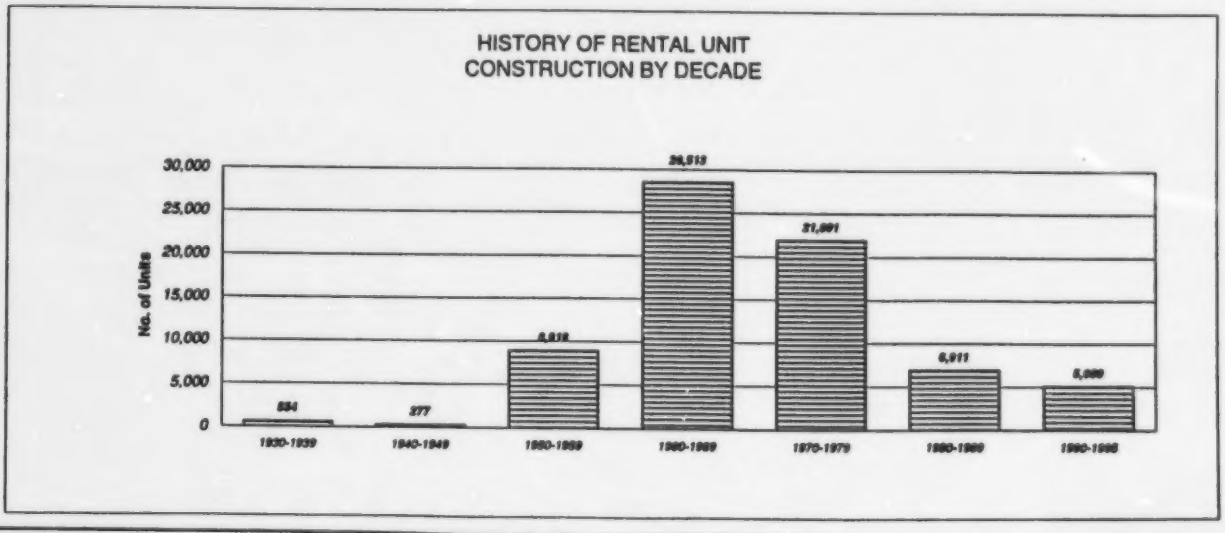

Note: Unit Costs calculated as Total Costs for each age group divided by the total number of units in that age group.

# Chart A-1 - City of Toronto and York - Building Universe

| Age Range | Total Number of Buildings* | Total Number of Units | Average Number of Stories Above Grade | Average Number of Stories Below Grade | Average Number of Parking Stalls/Unit Inside | Average Number of Parking Stalls/Unit Outside |
|---|---|---|---|---|---|---|
| 1930-1939 | 11 | 554 | 6 | 0.9 | 0.3 | 0.4 |
| 1940-1949 | 4 | 277 | 7 | 1.0 | 0.4 | 0.4 |
| 1950-1959 | 116 | 8,918 | 7 | 1.0 | 0.5 | 0.5 |
| 1960-1969 | 227 | 28,513 | 11 | 1.1 | 0.8 | 0.6 |
| 1970-1979 | 88 | 21,891 | 17 | 1.5 | 1.1 | 0.6 |
| 1980-1989 | 54 | 6,911 | 10 | 1.2 | Insufficient Data | Insufficient Data |
| 1990-1995 | 46 | 5,050 | 9 | 1.3 | Insufficient Data | Insufficient Data |
| Totals | 546 | 72,114 | | | | |

Note: * Number of Buildings After Prescreening



# Sampling Process

Once the buildings were sorted and screened, phone numbers were added to the database where available. This involved assistance from the Ministry of Municipal Affairs and Housing and from The Fair Rental Policy Organization of Ontario. Acquisition of contact names and phone numbers became a major hurdle in the sampling process. Of the 546 buildings in the sample universe only 145 were provided with phone numbers. Of these 145 buildings, 101 building contacts were made to solicit buildings for the Study. This represents 70% of the buildings provided with contact names and phone numbers.

## Reasons For Not Participating

As participation in the study was voluntary, securing buildings for the study became problematic. The effect was that the sampling of buildings deviated from a simple, random selection of buildings from the sample universe to a guided sampling of buildings from building managers that were willing to participate.

The reasons given for not participating are listed below.

1. No answer ..... 6
2. Not interested in participating - too busy ..... 5
3. Not interested - no reason given ..... 4
4. Wanted separate contract with GRG (concerns about confidentiality) ..... 4
5. Included then cancelled (1 private, 2 social) ..... 3
6. Included and withdrawn because not within geographic boundaries ..... 3
7. Volunteered but rejected because not within geographic boundaries ..... 2
8. No response after agreeing to consider participation ..... 2
9. Listing in database inaccurate (e.g. 3 floors residential of 26 storey building) ..... 1

Total non-productive contacts ..... 30 out of 101(30%)

Of the buildings that declined to participate, the majority were private and public co-operative non-profit housing who stated that they had no knowledgeable staff available to assist in the study. One large private management company declined to participate after having seen the level of input required from the building staff.

In general terms, we found that the non-mandatory nature of the study limited the accessibility to buildings in both the private and public sectors.

We anticipate that if the sampling process had not become a directed effort at securing buildings from the helpful landlords having larger portfolios, the rejection rate would have been substantially greater than 30%.

## Inputting Of The Data

Considerable information is obtained on the survey protocol forms and considerable inputting time is required to enter this data into the database. The tendency is to have non-technical staff perform the inputting. This was attempted and found to be highly problematic as, despite the technical expertise employed to compete the audits, there are explanatory notes, inconsistencies and occasional errors recorded on the field survey forms. In future, if non-technical staff are used to input data, additional time should be allocated to review and correct the database before performing analysis.

# Part 4 Overall Sample Analysis

# Part 4 Overall Sample Analysis

## Sample Size and Quality

This study attempted to obtain samples representative of the different construction types by selecting from various vintages of buildings. Chart A-2 on the following page illustrates the sample universe and the sample population. Chart A-2 can also be found in Appendix A (page A-12). In order that the sample provide useful information it must be representative. The sampling attempted to match the building age groups and the ownership type as the primary criteria for building selection. The result was a high proportion of buildings in the 1960s age grouping (28) with comparably fewer in the other groupings (16 in the pre-1960s group, 8 in the 1970s group, and 11 in the post-1970s group).

Both the size of the sample as well as its percentage representation are of importance to the quality of the information obtained.

### Size

This study included a total of 546 buildings in the universe population and 63 buildings in the study itself or 11.5% of the universe. The total number of buildings included was extended from 40 or 50 to over 60 to accommodate the addition of social housing to the study while attempting to not reduce the number of buildings that represented the privately owned buildings.

The sample size for the 1960s buildings is high at 28 (44%) of the 63 buildings sampled but representative of the universe population which contains 43% in the 1960s age group. The benefit of the large number of buildings in the 1960s sample is that a broader range of conditions can be reviewed. Of course, the smaller numbers of buildings in the other age groups allows less certainly about the sample representation of the universe.

Funding for the study was limited or the sample size could have been increased to include a greater number of buildings from the pre-1960s, 1970s and post-1970s age group.

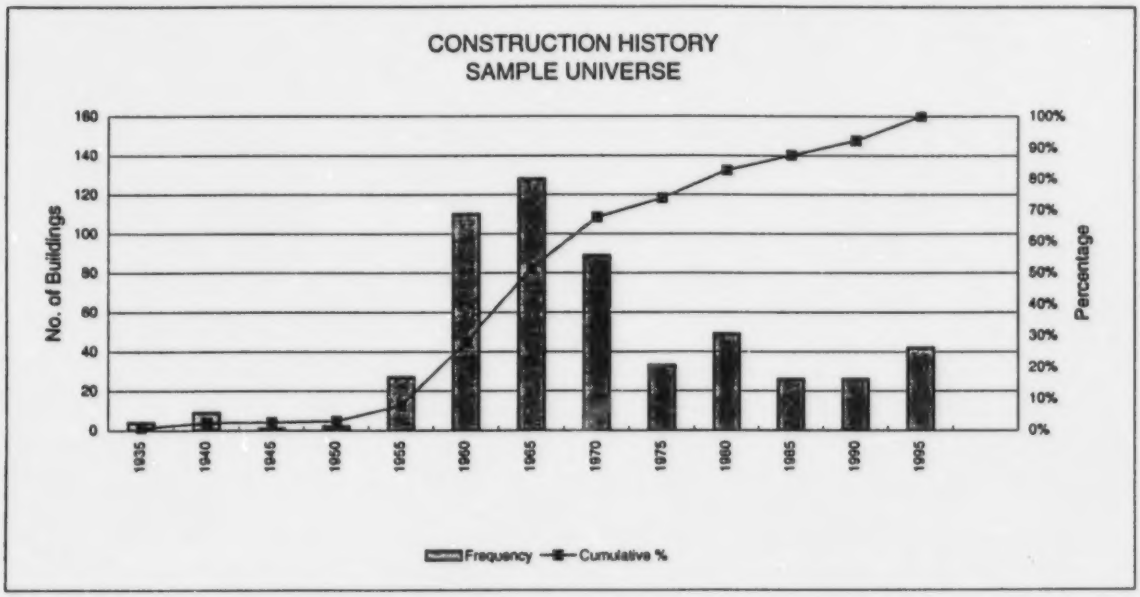
### Sample Quality

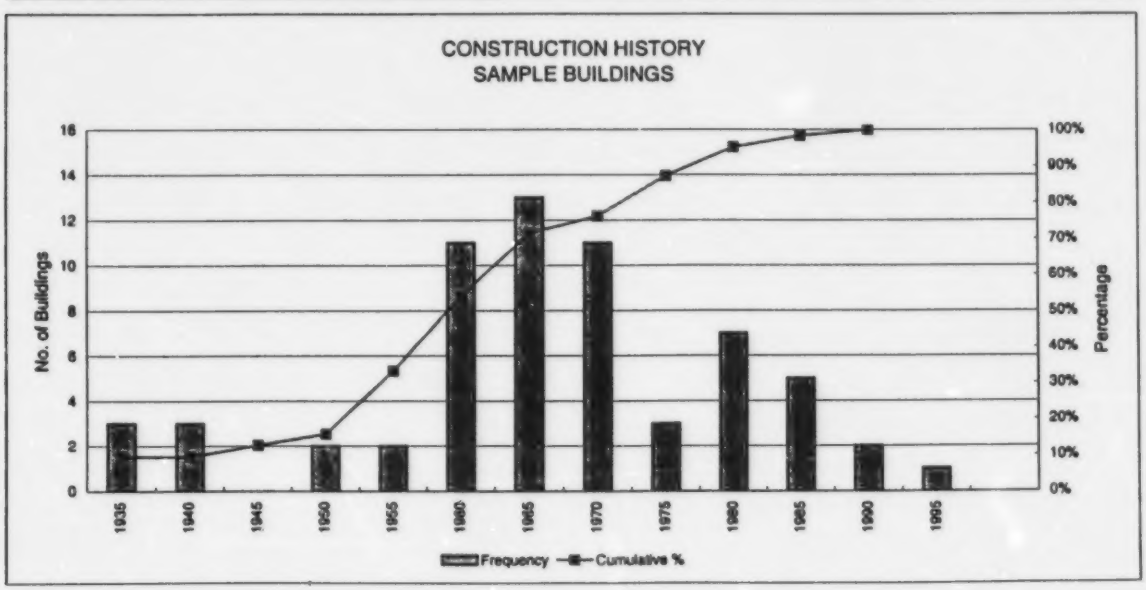
The distribution of buildings in the sample universe representing the distribution of the ideal sample is shown on the upper column chart on Chart A-2 on the following page. The distribution of the actual sample is shown on Chart A-2 on the lower column graph. A comparison of the charts shows that the sample quality is good within the broad grouping of buildings, i.e. pre-1960s, 1960s, 1970s and post-1970s; however, within the broad grouping there are some variations from the ideal sample. Specifically, a greater number of buildings in the 1930's age bracket were reviewed (5 instead of 1) and an offsetting lesser number of 1950s buildings were reviewed (8 instead of 13). Similarly, the ideal sample would have struck a balance between the 1980s and 1990s buildings; however, a larger proportion of 1980s buildings was included in the sample. The 1960s and 1970s building sample is considered to be a good representation of the construction period

The significance of the greater number of 1 930s buildings becomes relevant as it is three of those five buildings that contribute to the highest costs for repair per unit. Our analysis includes a discussion of both the costs per unit and the ratings assigned by the auditors, so the significance of the total costs can be properly considered.

# Chart A-2 - Sample Population and Building Universe

| Age Group | Sample Universe | | | | | Actual Sample Population | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Private Housing Buildings | Social Housing Buildings | Total Buildings | Proposed Sample Size | Proposed Percentage of Sample | Private Housing Buildings | Social Housing Buildings | Total Buildings in Sample | Actual Percentage of Sample | Grouped Proposed % of Sample | Grouped Actual % of Sample |
| 1930-1939 | 11 | - | 11 | 1 | 2% | 5 | - | 5 | 8% | | |
| 1940-1949 | 4 | - | 4 | 0 | 1% | 2 | 1 | 3 | 5% | 24% | 25% |
| 1950-1959 | 112 | 4 | 116 | 13 | 21% | 7 | 1 | 8 | 13% | | |
| 1960-1969 | 212 | 15 | 227 | 26 | 42% | 27 | 1 | 28 | 44% | 42% | 44% |
| 1970-1979 | 56 | 32 | 88 | 10 | 16% | 4 | 4 | 8 | 13% | 16% | 13% |
| 1980-1989 | 7 | 47 | 54 | 6 | 10% | 1 | 8 | 9 | 14% | | |
| 1990-1995 | 7 | 39 | 46 | 5 | 8% | - | 2 | 2 | 3% | 18% | 17% |
| TOTALS | 409 | 137 | 546 | 63 | 100% | 46 | 17 | 63 | 100% | 100% | 100% |



# Interpreting the Data

## THE USE OF HISTOGRAMS, QUARTILES AND AVERAGES

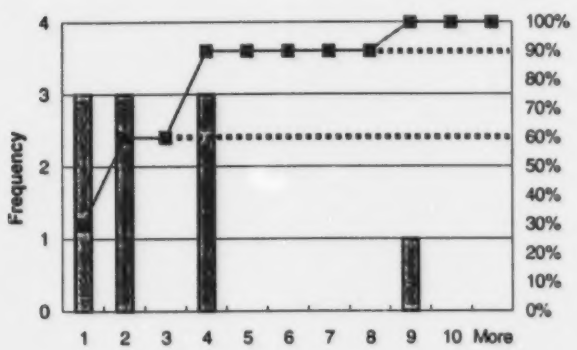
Interpreting the results of a survey of a single building is fairly simple; however, assessing the results of a population of 63 buildings is highly complex. There is a tendency in making assessments of buildings in a large sample population to come to an understanding of the condition by looking at averages. Averaging the results, however, eliminates any opportunity to understand how the sample is distributed. The better approach is to assess the data in a sample using a frequency distribution or histogram of the data.

### HISTOGRAMS

Histograms provide an opportunity to visualize the "shape" of the data. The following simple example illustrates the value of the histogram.

Consider a sample population of 10, in which there are three results equal to 1, three results equal to 2, three results equal to 4 and one result equal to 9. The average is 3 {(1+1+1+2+2+2+4+4+4+9)/10 = 3}. The average of "3" could as easily have come from a population with ten values of 3 or from five values of 2 and five values of 4. The fact that there is a value of 9 or three values of 1 in the sample is lost in the averaging.

A frequency distribution or histogram depicts the "shape" of the data allowing a better understanding of the data. A histogram of the data in our simple example is shown below.




The histogram charts included in this study also provide a line that depicts the cumulative percentage of the values. The cumulative percentage line helps to describe the data and makes comparisons between histograms easier.

The histogram opposite shows that 60% of the values are less than or equal to 3. It also shows that 90% of the values are less than or equal to 4.

Histograms are not always directly comparable because different scales are used to show information in the best way for each component.

If only averages were considered, then the fact that 60% of the sample is less than the average would not be known and the fact that there is a single value far greater than the others would be hidden by the average.

In the analysis of the building data, the histograms show the number of buildings with a given cost/unit for repair. For analysis, the quartile points, i.e., 25%, 50%, and 75% are used. A description of their use is given below.

### PER-UNIT COSTS AT QUARTILE POINTS

In order to make a quick comparison of the relative cost/unit across the various systems it is useful to examine the costs for repair at certain set fixed evaluation points. While the histogram charts can be reviewed for more detailed information, the quartile points provide a basis for comparing the histogram data.

Quartile points were chosen to represent the cost/unit data for buildings which need either no or minimal repairs (25%), the median cost/unit (50%), the cost/unit for most of the buildings (75%) and, the maximum cost/unit or the point at which 100% of the data have values less than that given.

An example from this study is given below,

**Garage - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $106 | $193 | $3,086 |
| 1960s | $104 | $297 | $906 | $4,127 |
| 1970s | $21 | $524 | $866 | $1,066 |
| Post-1970s | $24 | $54 | $326 | $720 |

This table presents the costs/unit for the 25%, 50%, and 75% of the building sample and for the maximum in terms of $/unit and gives the reader a good indication of the range of costs for the various age groups. For example, 25% of the 1960s garages will cost $104/unit or less to repair over the next 10 years, while 75% of the 1960s buildings cost $906/unit or less; however, another 25% of the buildings have higher costs to a maximum of $4,127/unit. While other points in the cumulative percentage curve of the histogram could have been selected, the quartile points are believed to give a reasonable description of the data.

The quartile points for the ratings obtained are assessed in a similar way.

### AVERAGES

While histograms allow a better understanding of the data distribution, averages can be used to reasonably describe a range of values that must be reduced to a single number to permit ease of comparison with other average values. For instance, it is easier to compare the average cost for repairs of pavement with the average cost for repair of windows than it is to compare the histograms for the range of costs for each of these systems.

It is also easier to graphically represent averages of costs for a set of several systems than it is to try to compare the histograms for two or more different systems. This report provides graphical representation of average values in the form of pie charts or in the form of column charts to allow the reader to visualize the results of the data.

There are two ways in which averages are presented.

1. As an average of the cost/unit values for a selection of buildings, i.e. by age group, or to include all buildings.
2. As total costs divided by total number of units for a selection of buildings.

This study considers the population of buildings in four age groups, pre-1960s, 1960s, 1970s and post-1970s. If an average of the costs for a specific set of criteria within an age group is desired, it can be obtained by averaging the costs/unit in that age group for the desired criteria. For instance, an average cost per unit for window repairs can be calculated for the 1960s vintage buildings in the next 3 to 5 year period by averaging the 3 to 5 years cost/unit for each of the 1960s buildings. If an average of the cost per unit for the window repairs for the whole population in the 3 to 5 year period is desired, it is not appropriate to take the average of the average per unit costs for the pre-1960s, 1960s, 1970s and post-1970s buildings. An average of averages would be correct only if there were the same number of units in each age group. As this is not the case in this study, it is more appropriate to calculate the average using the per unit costs for every building.

# Population Characteristics

## Ownership, Management And Superintendence Tenure

To begin to understand the buildings in the sample universe, the study undertook to assess the demographics of the sample population. This includes the nature of the ownership, the tenure of ownership, management and superintendence, and the age of the buildings for these various parameters. The relative merit of these parameters should be reviewed with caution as the sample was affected by the relative cooperation of the owners that participated in the study. The study found the following.

**Tenure of Ownership - As % of Sample**

| Age Grouping | % of sample | Average Cost ($/unit) |
|---|---|---|
| less than 1 year | 8% | $7,258 |
| 1 to 2 years | 6% | $3,450 |
| 3 to 5 years | 5% | $4,934 |
| 6 to 10 years | 10% | $8,938 |
| more than 10 years | 70% | $7,972 |

In general, the largest proportion of the sample (70%) have been in the same ownership for 10 years or more and the majority of those buildings are 1960s and pre-1960s buildings. The *Average Costs ($/unit)* column added to the table should not be interpreted as an indication that owners that have held buildings for longer periods are allowing the buildings to fall into disrepair. As will be shown later in this report, the per-unit cost for repair is linked to the age of the buildings with the older buildings costing much more per unit than the newer buildings.

**Tenure of Ownership - By Building Age Group**

| Age Grouping | Less Than 1 Year | 1 to 2 Years | 3 to 5 Years | 6 to 10 Years | More than 10 Years |
|---|---|---|---|---|---|
| Pre-1960s | 0% | 0% | 0% | 25% | 75% |
| 1960s | 18% | 4% | 11% | 0% | 68% |
| 1970s | 0% | 0% | 0% | 0% | 100% |
| Post-1970s [1,2] | 0% | 27% | 0% | 18% | 45% |

(1) 9% of 1970s buildings did not report tenure.

(2) The post-1970s buildings are primarily social housing which would be a stable owner,

The post-1970s buildings are primarily social housing (10 of 11 buildings, or 91% - see also Chart 2 Appendix A, page A-12) which would be a stable owner. The lesser years of ownership in the post-1970s buildings represents the fact that these buildings are new, not that the buildings have changed ownership.

The ownership of buildings is most often greater than 10 years, possibly indicating that repair and replacement cost recovery for the buildings could be justified over the longer term.

**Tenure of Management**

| Age Grouping | % of sample | Average Cost ($/unit) |
|---|---|---|
| less than 1 year | 19% | $7,839 |
| 1 to 2 years | 18% | $6,387 |
| 3 to 5 years | 15% | $9,610 |
| 6 to 10 years | 21% | $7,500 |
| more than 10 years | 27% | $6,972 |

Management tenure is somewhat more volatile than the ownership of the building Though there is some tendency for management over 10 years, there appears to be no significant trend for buildings of a particular age group to change management The costs shown should not be interpreted as indicative of effects of management tenure as the primary factor is the age of the building

**Tenure of Management - By Building Age Group**

| Age Grouping | Less Than 1 Year | 1 to 2 Years | 3 to 5 Years | 6 to 10 Years | More than 10 Years |
|---|---|---|---|---|---|
| Pre-1960s | 0% | 19% | 19% | 38% | 25% |
| 1960s | 39% | 11% | 11% | 11% | 29% |
| 1970s | 12% | 12% | 12% | 0% | 63% |
| Post-1970s [1,2] | 0% | 36% | 18% | 36% | 0% |

(1) 9% of 1970s buildings did not report tenure.

(2) The post-1970s buildings are primarily social housing which would be a stable owner. The lesser years of management in the post-1970s buildings reflects the fact that these buildings are newer, not necessarily that the buildings have changed ownership.

The management of the 1970s buildings tends to be longer-term, possibly indicating more stability in that age grouping and reflecting the longer term ownership of the 1970s buildings in the sample.

**Tenure of Superintendence**

| Age Grouping | % of sample | Average Cost ($/unit) |
|---|---|---|
| less than 1 year | 17% | $5,777 |
| 1 to 2 years | 11% | $6,062 |
| 3 to 5 years | 30% | $5,822 |
| 6 to l0 years | 21% | $10,443 |
| more than 10 years | 21% | $6,972 |

**Tenure of Superintendence - By Building Age Group**

| Age Grouping | Less Than 1 Year | 1 to 2 Years | 3 to 5 Years | 6 to 10 Years | More than 10 Years |
|---|---|---|---|---|---|
| Pre-1960s | 6% | 0% | 25% | 38% | 31% |
| 1960s | 18% | 11% | 32% | 18% | 21% |
| 1970s | 25% | 0% | 38% | 12% | 25% |
| Post-1970s (1,2) | 27% | 36% | 27% | 9% | 0% |

(1) The post-1970s buildings are primarily social housing which would be a stable owner. The lesser years of superintendence in the post-1970s buildings reflects the fact that these buildings are newer, not necessarily that the buildings have changed ownership.

As described in connection with ownership, the post-1970s buildings are primarily social housing which would be a stable owner. The lesser years of management in the post-1970s buildings reflects the fact that these buildings are newer not that the buildings have changed ownership.

The term of superintendence for the buildings is also volatile with no significant trend. There appears to be some indication of a trend to longer superintendent tenure in the pre-1960s buildings.

## Basic Characteristics Of Study Buildings

The characteristics typical of the buildings in the study can be discerned from the inventory data obtained during the survey. Each period of construction produced different construction types and therefore, presents different repair issues to building owners. In general terms, the survey confirms that over 50% of the private high-rise rental units constructed were built in the 1960s (212 of 417). Even with the inclusion of the social housing stock added, largely in the latter part of the 1970s and through the 1980s and 1990s, the single largest proportion of the rental stock, social and private, is in the 1960s at 41% (227 of 546). To mirror this critical characteristic, our sample included 44% of the 63 buildings from the 1960s housing stock.

### 1930s Buildings

The buildings in the study of the 1930s average 6 stories above grade and have an average of 55 units. This may be skewed by the exclusion of buildings less than 5 stories above grade. There are numerous buildings constructed in the 1930s, 1940s and into the 1950s that are less than 5 storeys in height. Specifically, three-storey walk-up buildings were common.

### 1940s Buildings

The buildings in the study of the 1940s average 7 stories above grade and have an average of 70 units. This too may be skewed by the exclusion of buildings less than 5 stories above grade. Construction slowed in the 1940s to a minimal 4 buildings in the sample universe.

### 1950s Buildings

The buildings in the study of the 1950s average 7 stories above grade and have an average of 77 units. This too may be skewed by the exclusion of buildings less than 5 stories above grade.

### 1960s Buildings

The buildings in the study of the 1960s average 11 stories above grade and have an average of 125 units. The 1960s buildings seem to have similar floor plans as buildings of earlier decades, with 10 to 12 units per floor, but were 50% taller than the buildings of the earlier decades.

### 1970s Buildings

The buildings in the study of the 1970s average 17 stories above grade and have an average of 250 units. Buildings of the 1970s, though fewer in number than those of the 1960s, (only 88 in the sample universe vs. 227 from the 1960s), were much taller at 17 storeys on average and included more units per floor (average 14 to 15). This increase in size in the 1970s buildings has not been carried through to the 1980s and 1990s.

### 19805 and 1990s Buildings

The buildings in the study of the 1980s average 10 stories above grade and have an average of 128 units. The buildings in the study from the first half of the 1990s average 9 stories above grade and have an average of 110 units. Those buildings returned to the lower, 10 and 9 storey height with 12 to 13 units per floor. The increased number of units per floor is related to the increased number of bachelor and one-bedroom units typical of social housing.

## Building Typology

The study protocol assessed in detail the characteristics of the buildings to determine the nature of the construction of the buildings in the different age groupings. The data is tabulated in Appendix C and summarized in the following sections of the report under headings representing each of the seven building systems assessed, i.e., *Site, Structure, Building Envelope, Mechanical, Electrical, Life Safety,* and *Elevators.*

In addition, the building typology information includes subsections for the subsystems assessed within the seven main building systems listed above. For example, the *Site* system was examined under the sub-heading or subsystems of *Pavement and Walkways* and *Site Structures,* and the *Structure* system was examined under the subsystems of *Garage, Balconies,* and *Building Framing.*

## Issues Raised By Tenants and Staff and Ongoing Repairs

The survey protocol requested input from the building staff on issues of concern, raised either by the tenants or staff. These are summarized in the following sections of the report. Such issues are not always specific in relation to a visible flaw but are generalizations made by the staff. The staff were prompted by a set of anticipated concerns and asked if other concerns should be recorded.

Where information was made available by the building staff on repairs made and proposed to be made, it is included in the assessment and compared with the costs for repair noted by the auditors. The information obtained directly from the building owners was not complete. In total only 11% of the buildings submitted complete survey forms. Further attempts were made to complete the forms by additional telephone calls and by re-sending the input forms for their input.

# Costs by Building System and Subsystem

## NORMALIZING THE COSTS

The costs presented in this report are the per-apartment unit costs. Unless all buildings are identical, the total costs for the repair of the sample buildings are not useful as a basis for comparison. Since buildings in the study differ by age, size and construction, a normalized means of comparison was developed based on the apartment unit.

As there was some query in the steering committee meetings as to the potential impact on costs for tall buildings vs. short buildings, the cost/floor and the cost/unit have been calculated for all buildings and compared. This is shown on Chart D-1 in Appendix D - Average Cost Charts (page D-1).

The values of cost/unit and cost/floor were normalized by calculating the difference between each value and the minimum value as a percentage of the range of values. The downward slope of the two lines indicates that the cost/floor and the cost/unit both decrease as the number of floors increases and as the number of units increases. The slope of the cost/unit line is steeper than the slope of the cost/floor line. This indicates that the number of units has more of an impact on the cost than the number of floors. Therefore, the cost/apartment unit is the basis for assessment throughout this report. A further discussion of how normalization was completed is included in Appendix D (page D-2).

## COST DATA SUMMARIES

The following sections provide an analysis of the survey results by building system and subsystem, including the following:

- Typology of the building components,
- Issues raised by the Staff and the Ongoing Repairs,
- Costs and ratings given on a quartile basis, and
- Comments on the findings.

Appendix D contains charts that summarize the data. Column charts are used to illustrate the distribution of total costs. The total costs are presented by building system and by time frame for repair (Immediate, 1 to 2 years, 3 to 5 years and 6 to 10 years) as a percentage of total costs in Charts D-2 and D-3. For each building system and subsystem, the unit costs are shown by age group (pre-1960s, 1960s, 1970s, post-1970s) in Chart D-4 and D-5. Chart D-6 presents the unit costs by time frame for each subsystem. Charts D-7 to D-14 show the unit costs by age group and subsystem, including a breakdown by time frame. Charts D-15 to D-19 present histograms for all building and for each age group. The charts in Appendix D form the basis of the comments made in the discussions of each of the seven building systems, which follows.

For more detailed review, the histograms in Appendix E illustrate the distribution of costs/unit for each of the 21 subsystems over the entire sample and by the four age groups, and the ratings for each of the major building systems.

# Site

The "Site" components include the Pavements and Walkways and the Site Structures, including retaining walls, fences, and pools. The costs for the Site systems is generally low being 2% of the total costs for all buildings over the next 10 years. The majority of the Site repair and replacement costs are in the Pavement and Walkways for the pre-1960s and 1960s buildings, with only a small proportion required immediately. A discussion of the subsystems follows.

## PAVEMENTS AND WALKWAYS

### TYPOLOGY

The pavement and walks are principally asphalt at driveways with concrete walks. A detailed description of the typology is tabulated in Appendix C. Tables C/1-1A to C/1-1C describe the pavement and walkways. Asphalt and concrete are the principal materials used; flagstone and interlock is far less common. Of interest to repair scenarios is the amount of pavement over the garage roof slab and the total amount of the pavement. Unfortunately, the survey forms were not always completed correctly with respect to identifying percent over and not over the garage, so assumptions were made in data entered. The buildings constructed prior to the 1960s generally occupy a large proportion of the site area. Pavements are often limited to surface parking and service area driveways.

The site coverage is substantially greater in the 1960s buildings than for any other age grouping. As such, buildings of the 1960s can be expected to have high repair costs for pavement and walkways. In addition, as the 1960s buildings have a large percentage of asphalt over the garage (average 65%), the repair costs for the asphalt will usually be tied into the rewaterproofing of the garage roof slab.

### ISSUES RAISED BY TENANTS AND STAFF AND ONGOING REPAIRS

Building staff complained of potholes in the asphalt in 31% of the pre-1960s buildings over 50% to 100% of the area in 60% of the buildings. The 1960s buildings have pavement in better condition with potholes in 25% of the paved area on half of the buildings. The 1970s buildings and the post-1970s buildings have potholes on 10% of the area on *25%* of the buildings. The sidewalks, as well, have potholes though to a far lesser extent.

**Pavement and Walks - Complaints**

| Age Grouping | Potholes in Pavement | Locations[1] | Potholes in Walkways | Locations |
|---|---|---|---|---|
| Pre-1960s | 31% | 20% - 100% area<br>40% - 50% area<br>20% - 25% of area<br>20% - 20% of area | 6% | 100%-5% of area |
| 1960s | *25%* | 29% - 50% area<br>14% - 10% of area<br>57% - 5% of area | 7% | 50%-40% area<br>50% - 30% of area |
| 1970s | 25% | 100% - 10% of area | 12% | 100%- 10% of area |
| Post-1970s | 9% | 100% - 10% of area | 0% | N/A |

(1) Expressed as x% of those reporting finding y% applicability, i.e. 20% of buildings reported 100% of area has potholes.

## PAVEMENT AND WALKWAYS - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/1-1. The histogram giving the breakdown by age group is shown on Chart E/1-1A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Pavement and Walks - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $40 | $77 | $202 | $444 |
| 1960s | $19 | $34 | $123 | $620 |
| 1970s | $6 | $44 | $86 | $142 |
| Post-1970s | $3 | $7 | $34 | $425 |

**Pavement and Walks - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 11 | 29 | 34 | 45 |
| 1960s | 11 | 26 | 32 | 42 |
| 1970s | 8 | 19 | 25 | 35 |
| Post-1970s | 5 | 17 | 22 | 39 |

The expenses for the pavement and walk repairs are spread fairly evenly across all time frames for the pre-1960s buildings. For the 1960s buildings, most costs are in 1 to 2 years and in 6 to 19 years. For the 1970s building, most costs are in 1 to 2 years and 3 to 5 years. For the post-1970s buildings, most costs are in 1 to 2 years.

The pre-1960s buildings have higher 25%, median (50%) and 75% costs than the 1960s, 1970s and post-1970s buildings. Considered with the high incidence of complaints about the potholes in the pavement of the pre-1960s building pavement and the inventory data which found that the average area of pavement for the pre-1960s buildings was less than 40% of the area of pavement found on the 1960s buildings (1,678$m^2$ vs. 4,272$m^{2)}$, the high cost/unit for the pre-1960s buildings would indicate that the pre-1960s buildings have reached the age where extensive asphalt replacement is required.

Also contributing to the greater cost/unit for the older buildings is the manner in which the asphalt repair is calculated. Buildings with garages below grade generally have a high percentage of the pavement over the garage. Pavement replacement costs are included in the garage rewaterproofing costs. The 1960s buildings had roughly 65% of the asphalt over the garage; whereas, all other age groups had 36% or less of the asphalt over the garage. There is an anomaly in the maximum cost/unit arising from one post-1970s building with only 36 units and a large paved area resulting in a high per-unit cost of $425.

The rating number for the pavement and walks generally decreases for the newer buildings; however, the decrease is proportionately less than the decrease in the per-unit costs. This would seem to indicate that the condition of the newer pavements is not much better at the newer buildings but the cost per unit is reduced due to cost efficiencies in the actual increased number of units. The complaints also noted potholes in the newer pavements confirming that the newer pavements also require work.

## SITE STRUCTURES

### TYPOLOGY

The "Site Structures" include retaining walls, swimming pools, fences and site security buildings. Tables C/1-2A to C/1-2D describe the site structures. Most all sites had some form of a retaining wall except the buildings from the 1970s. This is not a design feature but more likely a function of the site conditions that is unrelated to age. Where there are retaining walls, the majority, (73%) are cast-in-place concrete.

The buildings of the 1960s are the only building vintage that included swimming pools. Swimming pools are usually painted cast-in-place concrete with concrete decks. These would be outdoor pools and would be seasonal in use and highly maintenance oriented. While it is more common to include swimming pools in newer condominium buildings, the sampled buildings are rental properties and social housing where the addition of a swimming pool may seem to be a lavish accessory expense. The majority of the fences are metal picket-type, though there are large percentages of wood and of chain link.

### ISSUES RAISED BY TENANTS AND STAFF

Retaining walls are a problem for only 9% of the pre-1960s buildings but are a concern for 23% of the 1960s buildings. Fences are a problem for 13% of the pre-1960s buildings and are a concern for 19% of the 1960s buildings and 10% of the post-1970s buildings. Swimming pools are a concern in 33% of the 1960s buildings.

**Site Structures - Complaints**

| Age Grouping | Retaining Walls | Fences | Swimming Pool |
|---|---|---|---|
| Pre-1960s | 9% | 13% | N/A |
| 1960s | 23% | 19% | 33% |
| 1970s | N/A | 0% | N/A |
| Post-1970s | 0% | 10% | N/A |

Note: Percentages are of those sites with such features.

### SITE STRUCTURES - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/1-2. A more detailed breakdown by age group is shown in Appendix E on Chart E/1-2-A. The groupings of the costs and ratings by quartile are given below.

**Site Structures - Quartile Unit Costs**

| Age Grouping | *25%* less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $9 | $15 | $101 |
| 1960s | $2 | $21 | $35 | $88 |
| 1970s | $4 | $9 | $15 | $62 |
| Post-1970s | $0 | $0 | $23 | $194 |

**Site Structures - Quartile Rating**

| Age Grouping | *25%* less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 15 | 18 | 36 |
| 1960s | 4 | 15 | 26 | 47 |
| 1970s | 5 | 10 | 11 | 21 |
| Post-1970s | 0 | 0 | 14 | 37 |

The costs are reasonably small and uniformly distributed between the repair periods for all age groups.

The repair cost values that include 75% of the population are relatively low for all age groups though higher for the 1960s buildings; however, there is a small proportion of buildings in each age grouping that have relatively high costs. This would indicate that some buildings have fences and retaining walls requiring replacement. The 1960s buildings also have swimming pools on 29% of the buildings that are a concern to the building staff.

The ratings for the site structures exhibit a wide range, from 0 to 47. The highest ratings are roughly double the 75-percentile rating indicating that some buildings require urgent repairs to the site structures. This is related to the swimming pools in the 1960s buildings and to the condition of fences and retaining walls in the post-1970s buildings.

# Structure

The "Structure" of the building includes the Garage, the Balconies and the Building Framing. Garages and balconies have generated significant repair costs for buildings. Garage suspended slabs and roof slabs are being repaired and re-repaired and waterproofed as part of ongoing building maintenance. Exposed building framing is often repaired at the same time as the balcony slabs and includes the exposed slab edges at floors, exposed shear walls and end walls.

The costs for the Structure is reasonably high being 15% of the total costs for all buildings over the next 10 years (Chart D-2). The majority of the Structure repair and replacement costs are in the 1960s and 1970s buildings with most of the repairs being required in 1 to 2 years. A discussion of the subsystems follows.

## GARAGES

### TYPOLOGY

The detailed summary of the building typology for the garage is listed in Appendix C. Tables C/2-1A to C/2-1H describe the garages. The garage components include the roof and waterproofing system on the roof, the suspended slabs and waterproofing (if there are multi-levels to the garage), the slab on grade and the ramps, walls and columns. The primary cost items are generally the roof, the suspended slabs and the waterproofing, so only those items are detailed below. Since the nature of overburden above the below-grade garages impacts on the costs for repair, the type of overburden is also included in the summary given in Appendix C.

### ISSUES RAISED BY TENANTS AND STAFF AND ONGOING REPAIRS

The garages are a significant concern to the building staff. The pre-1960s buildings have no suspended parking levels; however, there is a high proportion of roof leak complaints. Both roof leak and wall leak complaints are very common at the 1960s buildings as well as leaks in the suspended floor slabs. The 1970s buildings have fewer complaints of roof slab leaking; however, the walls and intermediate level slab leaks are a common concern. Buildings of the post-1970s have no complaints about roof leaks and intermediate level slab and wall leaks are less frequent.

**Garage - Complaints**

| Age Grouping | Garage Roof Leaks | Wall Leaks | Suspended Slab Leaks |
|---|---|---|---|
| **Pre-1960s** | 46% | 15% | N/A |
| **1960s** | 67% | 52% | 67% |
| **1970s** | 17% | 43% | 40% |
| **Post-1970s** | 0% | 13% | 25% |

Note: Percentages are of those sites with such features.

### GARAGE ROOF SLABS

The sample found that the majority of the garage roof slabs are cast-in-place flat slab concrete with a hot-applied rubberized membrane under asphalt and landscaping. The roof slab waterproofing in the pre-1960s buildings was typically hot-applied rubberized membrane. As such, it is likely that the sheet and built-up systems reported are replacement membranes.

### GARAGE SUSPENDED SLABS

The sample buildings indicate that most garages are underground, that garages of the pre-1960s buildings have no suspended slabs and that less than one-half of the garages of the 1960s (46%) have suspended levels. The 1970s buildings, on average, have 1.5 levels and the post-1970s buildings have, on average, 1.2 to 1.3 levels (Appendix A, Chart 1). As such, the buildings of the 1970s would have greater costs for repair of the suspended slabs. Of particular interest and concern is the apparent lack of use of waterproofing on the suspended slabs. The sampled buildings found that between 40% and 60% of the buildings, on average, had no waterproofing membrane on the suspended slab. This would account for the high incidence of reported leaking in the 1960s and 1970s buildings. Those buildings that were waterproofed mainly used hot-applied rubberized asphalt, usually with a mastic asphalt topping. Those that are not waterproofed did not even have a sealer applied in an average of 20% of the cases for the post-1970s and 1970s buildings and an average of 33% of the cases for the 1960s buildings.

Slab on grade construction in the sample is exposed and without a membrane. Sealers are more prevalent in the 1970s and post-1970s buildings at 57% for each age group and only on average on 15% and 11% of the pre-1960s and 1960s buildings, respectively. The presence or absence of a sealer on the slab on grade has little effect on repair costs.

### GARAGE - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/2-1. The histogram giving the breakdown by age group is shown on Chart E/2-1-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Garage - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $106 | $193 | $3,086 |
| 1960s | $104 | $297 | $906 | $4,127 |
| 1970s | $21 | $524 | $866 | $1,066 |
| Post-1970s | $24 | $54 | $326 | $720 |

**Garage - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 15 | 18 | 36 |
| 1960s | 4 | 15 | 26 | 47 |
| 1970s | 5 | 10 | 11 | 21 |
| Post-1970s | 0 | 0 | 14 | 37 |

The highest garage expenditures across all age groups are in the 1 to 2 and 3 to 5 year periods with the 1960s buildings having the more urgent need in the 1 to 2 year period.

The costs per unit at the 75% level differ dramatically between the 1960s and 1970s buildings and those of the pre-1960s and the post-1970s buildings. The 1960s and 1970s buildings have suspended parking levels, many of which are not waterproofed. This results in ongoing high repair costs. Some of the worst cases of leaking and deterioration are requiring extensive through-slab repair and rewaterproofing. In none of the buildings is slab replacement considered. If that were the case, the costs would be higher still, in the order of $7,500/unit.

The pre-1960s buildings have a lower quartile cost of $0 reflecting the finding that roughly 25% of those buildings have no garages. All other age groups indicate that there is a cost for garage repair. The upper quartile to the maximum reached over $3,000/unit for the pre-1960s buildings and over $4,000/unit for the 1960s buildings. These repairs include suspended slabs and waterproofing. Since we noted that between 40% and 60% of the garage slabs from the 1960s through to the post-1970s were not waterproofed, there will be high costs for repair of these structures in the future.

The 1970s buildings have high cost/unit for the 50 and 75-percentile level at $524 and $866/unit, respectively, but the maximum cost is comparably less than the other age groups at $720/unit.

The rating figures for the garages indicate maximum ratings that are only about double the 75% rating. By comparison, the maximum costs of the garages are considerably greater than the 75% cost, especially for the pre-1960s and 1960s buildings. This disparity is a reflection of the timing for the repair being deferred.

The ratings at the 75% level indicate that the buildings of the 1970s and post-1970s are not in much better condition than those in the pre-1960s and 1960s age group. The 1960s age group has not only the greatest per unit cost but is in the worst condition. This would indicate that the older buildings have reached the age where extensive concrete repair and rewaterproofing of garage roof slabs is required and the cost is unfortunately spread over fewer units.

These costs and ratings indicate that while the technology for repair exists, the owners have not always implemented the repairs.

## BALCONIES

### TYPOLOGY

The detailed summary of the building typology for the balconies is listed in Appendix C. Tables C/2-2A to C/2-2G describe the balconies. Balconies include the slabs, the guards and the materials comprising the posts, and panels or pickets forming the guards. Also noted are the coverings often applied to balconies and the finishes.

Prior to the 1960s, a large percentage of the buildings did not have balconies. In the 1960s buildings the balconies were found on the entire sample; however, the buildings of the 1970s and later were constructed with only roughly 75% having balconies. The repair costs for the buildings in the 1960s, related to balconies, can be expected to be high relative to other age groups. We doubt that the return to buildings without balconies is related to the costs for repair, as the balcony repair issue has been known for only the past 10 years. The return to buildings without balconies is related to the tendency for public non-profit housing to exclude balconies from the buildings built in the 1980s and 1990s.

### ISSUES RAISED BY TENANTS AND STAFF AND ONGOING REPAIRS

There are no complaints about the slabs or guards for the pre-1960s buildings. The balcony slabs are responsible for complaints of leakage in only 6% of the 1960s buildings, 33% of the 1970s buildings and 12% of the post-1970s buildings. Guard height is not an issue, but guard openings width is an issue in 4% of the 1960s buildings. All complaints were recorded from staff except the leaking of slabs in the post -1970s buildings, which were recorded as from tenants.

**Balcony - Complaints**

| Age Grouping | Slab Leaks | Guard Height | Guard Openings |
|---|---|---|---|
| Pre-1960s | 0% | 0% | 0% |
| 1960s | 77% | 0% | 4% |
| 1970s | 33% | 0% | 0% |
| Post-1970s | 12% | 10% | 0% |

Note: Percentages are of those sites with such features.

### BALCONY SLABS

The sampled buildings indicate that less than 15% of the buildings in the 1970s and later used precast concrete for the slab structure. The primary construction method employed cast-in-place concrete. The buildings have exposed concrete surfaces though the older buildings tend to apply paint to the top and soffit. Carpet, which is generally considered to be detrimental to the durability of the concrete, is used in less than 8% of the sampled balconies except those of the 1960s where 13% of the balconies, on average, had carpet. The application of waterproofing in the 1970s and the pre-1960s buildings would indicate that those buildings had already been repaired, as waterproofing wasn't provided in new construction.

Balcony guards are most often steel although roughly one-half of the newer, post-1970s buildings have been using aluminum and roughly one-half of the older, pre-1960s buildings have retrofit to aluminum. Newer buildings are also using concrete guards.

### BALCONY GUARDS

The guards are most often painted steel panels or pickets of steel or aluminum. About a third of the pre-1960s buildings have glass or plastic panels. These guards are often repaired or reinforced at the time that the balconies are repaired. If code compliance for height, gap width or climbability is not present, the guards are

either replaced or modified. Often as well, the panels that cover the face of the balcony slabs are cut away to allow slab edge repair. On the buildings of the 1960s roughly half of the balconies have the slab face covered by the guard. This reduces to 29% in the 1970s and post-1970s buildings. The guard over the slab face would result in greater expense for balcony repairs for the 1960s buildings.

### BALCONY - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/2-2. The histogram giving the breakdown by age group is shown on Chart E/2-2-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Balcony - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $0 | $181 | $1,102 |
| 1960s | $88 | $326 | $678 | $1,330 |
| 1970s | $4 | $180 | $355 | $1,798 |
| Post-1970s | $0 | $23 | $90 | $2,011 |

**Balcony- Quartile Rating**

| Age Grouping | *25%* less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 0 | 15 | 41 |
| 1960s | 17 | 24 | 34 | 44 |
| 1970s | 8 | 12 | 30 | 43 |
| Post-1970s | 0 | 6 | 19 | 43 |

The majority of the expense for the balconies in pre-1960s is in 3 to 5 years. For the 1960s buildings and post-1970s buildings, the highest proportion of the cost is in 1 to 2 years. For the 1970s buildings, most of the cost is in the Immediate category.

The costs per unit at the 75% level for the 1960s buildings are much higher that those of the other time frames. The highest costs found are again orders of magnitude greater than the 75% level. The maximum cost category has more uniformity with the highest costs being in the $1,102/unit to $2,011/unit range for all buildings. There is an apparent difference in the condition observed at the 75% cost level and, therefore, the required amount of work, as confirmed by the ratings below. The 75% levels for the pre-1960s buildings are low, in part due to the fact that only 56% of these buildings have balconies. All the buildings in the 1960s and approximately 75% of the buildings in the 1970s and post-1970s have balconies.

The pre-1960s buildings have a median cost of $0/unit indicating over half of the sample have no balcony repair needs. Of the sample, 44% of the pre-1960s buildings have no balconies and, on the basis of the presence of waterproofing and aluminum guards, neither of which were common at the time of construction, at least 44% have already completed repairs. Still, there are some buildings in the pre-1960s group that require costly repair at $1,102/unit and fairly urgently based on the ratings.

The cost for balcony repair of the 1960s buildings ranges from $88/unit indicating minor repairs for the lower quartile to $678/unit for the 75% level, indicating extensive repairs are required for the majority of the buildings. The maximum was $1,330/unit indicating full slab face and guard replacement.

The 1970s buildings have a lower quartile cost of $4/unit, 50 percentile costs of $180 and 75 percentile costs of $355. These values are roughly half the costs for the 1960s buildings indicating that these buildings have not yet generated symptoms indicating the need for repair. One anomaly in the 1970s buildings ($1,798/unit), which accounts almost entirely for the large Immediate repair needs, is a building with glass panel balcony guards; at least 90% of the glass panels are broken and some are loose.

The post 1970 buildings as well have not generated symptoms indicating the need for repair. The anomalous high value for the maximum cost for balcony repair of the post-1970s buildings ($2,011/unit) is the result of extensive leaking and ponding on the balcony slabs and roughly $950/unit for brick spalling as a result of ponding.

The ratings for the balconies are higher for the 1960s buildings than for the other buildings but not proportionately greater when compared to the costs/unit.

The ratings at the 75% level indicate that the buildings of the pre-1960s and post-1970s are in better condition than those in the 1960s and 1970s age group. The ratings for the worst buildings are reasonably uniform at 41 to 44.

Repair of balconies tends to be a response to slab edge spalling brought on by carbonation of the concrete and corrosion of the reinforcing steel. The timing for these repairs is generally after 25 to 30 years of service. These costs and ratings indicate that while the technology for repair exists, the owners of the early 1970s and 1960s buildings have not always implemented the repairs.

## BUILDING FRAMING

### TYPOLOGY

The frame of the building is the primary structural system supporting the floor and lateral loads. Often, there are portions of the building framing that are not associated with balcony slabs or the garage that are exposed and will likely require repair. The interior portions of the structural framing rarely require repair unless there has been a change in use and overloading or unless there has been a latent construction or design flaw. The sample assessed the exposed portions of the building and the fire exit stair structure. Since the stairs are generally not repaired only the main framing structural components are summarized below.

The sample determined that the buildings of the pre-1960s used the composite steel joist and concrete floor system with load-bearing masonry for the majority of the buildings. Thereafter, cast-in-place concrete slabs supported by cast-in-place concrete walls and columns became the predominant method of construction.

The use of load-bearing masonry and composite flooring systems in the pre-1960s buildings results in minimal structural repair costs, as there will generally be no exposed floor slab except at balconies. Where there are exposed structural slabs and walls, these are listed under the exposed portions of the Building Envelope in the following section.

### ISSUES RAISED BY TENANTS AND STAFF AND ONGOING REPAIRS

**Building Framing - Complaints**

| Age Grouping | Leaks Through Slabs | Spalling of Slab Edges and Walls |
|---|---|---|
| Pre-1960s | 0% | 11% |
| 1960s | 17% | 25% |
| 1970s | 12% | 18% |
| Post-1970s | 25% | 18% |

The pre-1960s buildings with load-bearing masonry and minimal exposed structure exhibit few complaints. The 1960s and 1970s buildings which have exposed slab edges and exposed shear walls and end walls on roughly 60% to 70% of the buildings (see Appendix C - Building Envelope, Exterior Walls, Other Exposed Elements Table C/3-1D, page C-9) have complaints of leaking and spalling. The post-1970s buildings, which also have a high proportion of concrete end walls and concrete shear walls, also expressed complaints about leaks and spalls.

### BUILDING FRAMING - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/2-3. The histogram giving the breakdown by age group is shown on Chart E/2-3-A in Appendix E. Groupings of the costs and ratings by quartile are given below.

**Building Framing - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $0 | $5 | $286 |
| 1960s | $0 | $53 | $228 | $1,277 |
| 1970s | $0 | $5 | $25 | $275 |
| Post-1970s | $0 | $0 | $14 | $138 |

**Building Framing - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 0 | 14 | 21 |
| 1960s | 0 | 16 | 21 | 34 |
| 1970s | 0 | 9 | 35 | 45 |
| Post-1970s | 0 | 0 | 16 | 17 |

The majority of the costs are in the 1 to 2 year period for all age groups

The building framing repair costs/unit are low across all age groups in the 25% and 50% levels. The 75-percentile are also generally low except the 1960s buildings which have exposed slabs as well as exposed walls and are of the age when carbonation and corrosion affect the walls and slabs. Compared to the maximum per unit costs at other levels, which are orders of magnitude less, there are relatively few buildings have extensive repair needs.

The rating values for the building framing do not directly mirror the costs. The 1970s buildings have a higher rating than the ratings for the other age periods in the 75-percentile category and maximum category despite the markedly lower per-unit costs when compared to the 1960s buildings. This is because the 1960s buildings have a greater percentage of exposed floor slabs and concrete end walls requiring repair.

# Building Envelope

The Building Envelope includes the Exterior Walls, Windows and Exterior Doors, and Roofs. The components used and the design of the systems has evolved considerably over the past 50 years. The costs for repair of the building envelope components, including brick replacement, sealants replacement, window replacement and roof replacement, has become significant and the types of envelope systems and the components can have a profound effect on the repair costs.

The costs for the Building Envelope systems is reasonably high being 19% of the total costs for all buildings over the next 10 years. The majority of the Building Envelope repair and replacement costs are in the pre-1960s and 1960s buildings with most of the repairs being required in Window and Exterior Door systems in 1 to 2 years and 3 to 5 years. A discussion of the subsystems follows.

## EXTERIOR WALLS

### TYPOLOGY

The detailed summary of the building typology for the exterior walls is listed in Appendix C. Tables C/3- 1A to C/3-1F describe the exterior walls. The Exterior Wall system includes the exterior face, which may be brick veneer, cast-in-place concrete, precast concrete, or metal siding. If the walls are masonry, there will be a back-up wall consisting of block or steel studs. There may also be other exposed elements forming portions of the exterior walls, which would be part of the building framing.

Of interest is the wall design, whether or not the wall has a cavity, where the insulation is located and the insulation value, the flashing and drainage of the wall, and the presence of an air barrier. As most buildings did not have drawings, this information was not a matter of record. However, the auditors, in most cases, were able to provide an informed opinion based on site conditions,

The survey sample indicates that masonry walls have been the principal exterior wall material over the past 50 to 60 years. The use of masonry usually involves the use of a concrete back-up wall either 4-in. (30% to 40%) or 6-in.to 8-in. thick (50% to 60%). The 4-in. wide back-up wall is (to our understanding) a system that is unique to the Toronto area.

Steel stud walls entered as the back-up wall system in the late 1970s (14% of the 1970s and 20% of the post-1970s buildings) as a cost-savings measure and are still being built. Many inadequately designed and constructed steel stud back-up walls have resulted in repairs.

Where the primary wall system is not masonry, the walls are either cast-in-place concrete, precast concrete, or metal siding. The cast-in place concrete walls (4%) were found only in the 1970s buildings; the precast concrete walls were found on the 1970s and the post-1970s buildings, usually with cast-in-place end walls. Metal siding, as part of the original construction, was found on only 1% of the buildings and only in the sample of 1970s buildings.

The survey also confirms that the design of walls has evolved considerably from solid masonry in the pre-1960s buildings with no cavity and no drainage, through the 1960s, which saw the start of 12 mm cavities and drainage in roughly 10% of the walls. In the 1970s, cavity walls from 25 mm to 40 mm wide were used on 60% of the walls and flashing and weepholes for drainage are obvious on at least *25%* of the walls. In the post- 1970s buildings, all of the walls sampled have at least some cavity and most have flashing and weepholes.

Air barrier construction was infrequent throughout the sample though more prevalent (18%) in the post-1970s buildings.

Insulation is generally inside the wall and has steadily increased in average R value from an average of R 3.1 in the pre-1960s buildings to an average of R 9.1 in the post-1970s buildings. Cavity insulation, likely associated with a rain screen style design, was found at 13% of the 1970s and 27% of post-1970s buildings.

## ISSUES RAISED BY TENANTS AND STAFF

### EXTERIOR WALLS - COMPLAINTS

The complaints recorded mainly by staff, are related to leaks at the walls. The problems appear to be more frequent in the 1960s buildings and the post-1970s buildings than in the pre-1960s and the 1970s buildings.

| Age Grouping | Leaks |
|---|---|
| Pre-1960s | 12% |
| 1960s | 32% |
| 1970s | 25% |
| Post-1970s | 45% |

Note: the complaints are primarily leaking; however, there are some reports of spalling and efflorescence.

### EXTERIOR WALLS - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/3-1. The histogram giving the breakdown by age group is shown on Chart E/3-1-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Exterior Wall - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $11 | $164 | $390 | $1,443 |
| 1960s | $15 | $30 | $236 | $641 |
| 1970s | $39 | $75 | $230 | $616 |
| Post-1970s | $53 | $117 | $247 | $1,433 |

**Exterior Walls - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 15 | 17 | 27 | 47 |
| 1960s | 13 | 16 | 18 | 34 |
| 1970s | 13 | 16 | 24 | 45 |
| Post-1970s | 23 | 26 | 32 | 47 |

The majority of the expenses for the pre-1960s, 1960s, and 1970s buildings are in the 1 to 2 year period. The 1970s buildings also have relatively high costs in 3 to 5 and 6 to 10 years. The post-1970s buildings have immediate repair needs.

The exterior wall repair needs for buildings in all age groups indicates that over 25% of the buildings are projecting total costs less than $53/unit over the next ten years. Such repairs would typically involve isolated brick repair and repointing.

The pre-1960s buildings have a 50%-level cost of $164/unit with 75% level costs of $390/unit; whereas, the median cost of the 1960s buildings and 1970s buildings is far lower at $30/unit and $75/unit, respectively. The 75%-level cost of 1960s, 1970s and post-1970s buildings is reasonably consistent at $230 to $247/unit.

The anomalous high cost for the two buildings of the pre- 1960s relates to spalled solid masonry walls and cracked precast window sills on a building from the 1930s and a 1950s vintage building that has a deteriorated soffit requiring replacement in the next 6 to 10 years. The pre-1960s buildings have 33 and 42 units, respectively, thus increasing the per-unit cost. The anomalous high cost for the two buildings of the post-1970s relates to heavily damaged brick and leaking at mortar joints in a 247 unit, 1980s vintage building, with a 1 in. cavity wall, which requires repair now and a 36-unit, 1980s vintage building with wall damage related to leaking at the balconies (the same building causing the highest costs for balcony repair) which requires repair in 1-2 years. The high-cost buildings have recorded complaints of brick spalling.

The ratings for the exterior walls are reasonably consistent for pre-1960s, 1960s and 1970s buildings. The higher number in the post-1970s buildings corresponds to the higher per-unit costs for repair.

The higher costs for repair and the higher ratings for the 1980s and 1990s buildings would tend to indicate that the performance of the newer wall systems, using largely cavity-type walls, is not as good as the earlier wall systems employing thin cavities. It is not clear from the survey data whether the poorer performance is related to faulty construction or lack of attention to details, such as flashing and drainage of the walls. None of the repairs are associated with the steel stud back-up walls found on newer buildings. There is additional cost on newer buildings for repair of sealants, as there tend to be more caulked joints on the buildings in the 1970s and post-1970s buildings.

## WINDOWS AND EXTERIOR DOORS

The detailed summary of the building typology for the windows and exterior doors is listed in Appendix C. Tables C/3-2A to C/3-2J describe the windows and exterior doors. Windows include the configuration of the windows, the framing materials, glazing type, infill panels, and window sills, glazing method and weatherstripping. Exterior doors include, principally, the balcony doors.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints recorded mainly by staff are related to condensation, leaks and drafts. The problems appear to be more frequent in the 1970s buildings and the post-1970s buildings than in the pre-1960s and the 1960s buildings.

**Windows and Exterior Doors - Complaints**

| Age Grouping | Condensation[1][2] | Leaks[1][2] | Drafts[1][2] |
|---|---|---|---|
| Pre-1960s | 12%<br>50% at all windows<br>50% at 50% of windows | 12%<br>50% at 50% of windows<br>50% at 10% of windows | 19%<br>66% at 50% of windows<br>33% at 25% of windows |
| 1960s | 7%<br>56% at all windows | 25%<br>amount not specified | 43%<br>amount not specified |
| 1970s | 25%<br>amount not specified | 50%<br>amount not specified | 38%<br>amount not specified |
| Post-1970s | 27%<br>amount not specified | 36%<br>amount not specified | 18%<br>amount not specified |

(1) Expressed as % of sample, e.g. 12% of the pre-1960s buildings report condensation.

(2) Expressed as % of those reporting problems at % of windows/doors, e.g., 50% of the pre-1960s buildings report condensation at all windows and 50% report condensation at *50%* of the windows.

### TYPOLOGY

#### WINDOW REPLACEMENT

The study found that 43% of the buildings have replaced the windows and 8% have recaulked perimeters. Windows in buildings that have been replaced would also have been recaulked. Two-thirds of the replacements have taken place in the past 10 years (since 1989). The breakdown by age of building follows.

**Windows Replacement**

| Age Grouping | Percentage Replaced | No Data[2] | Year Work Done[3] | Age of Building at Replacement[3] |
|---|---|---|---|---|
| Pre-1960s | 75%<br>92%- 100% of windows<br>8% at 2% of windows | 6% | 1984 to 1989 - 16%<br>1990 to 1993 - 42%<br>1994 to 1997 - 33% | 25 to 30 years - 16%<br>31 to 35 years - 25%<br>36 to 40 years - 24%<br>40 to 50 years - 0%<br>50 to 60 years - 16%<br>60 to 70 years - 16% |
| 1960s | 50%<br>93% - 100% of windows<br>7% - 80% of windows | 0% | 1980 to 1983 - 7%<br>1984 to 1989 - 0%<br>1990 to 1993 - 50%<br>1994 to 1997 - 28% | 20 to 25 years - 14%<br>25 to 30 years - 49%<br>31 to 35 years - 14%<br>36 years - 7% |
| 1970s | 0% | 25% | N/A | N/A |
| Post-1970s | 0%[1] | 9% | N/A | N/A |

(1) Reported as sealed unit replacement in 10% of units, but is excluded from this summary as the replacement was incorrectly reported by the owner.

(2) No data filled in on survey form is assumed to mean that no replacement has been performed.

(3) Expressed as % reporting within the period specified.

On the basis of the replacement information obtained from the auditors and owners there has been a high proportion of window replacement in the pre-1960s and 1960s buildings but none as yet in the 1970s and post-1970s buildings. Window replacement in the 1970s buildings is now a predictable expense which, based on the data obtained, can be expected to occur after 25 to 30 years. We do not know if the replacements on the pre-1960s buildings that took place 50 to 70 years after construction are the first or subsequent generation replacements.

### Window Configuration

The windows used in buildings of the past 60 years are mainly punched openings ranging from 88% to 100% of the buildings having this type. In addition to punched openings, buildings also have other windows that are ribbon-type, being continuous horizontal bands, and slab-to-slab type with panels below operable windows. All of the pre-1960s buildings have punched window openings. Roughly 63% of the pre-1960s buildings have punched windows and no other type. Whereas 19% of the pre-1960s buildings have ribbon windows and 38% have slab-to-slab windows. The slab-to-slab windows represent a lesser amount of the window area in the pre-1960s buildings.

The buildings in the 1960s are also mainly punched windows, though a larger proportion (43%) have ribbon windows and a lesser proportion (14%) have slab-to-slab windows. Buildings of the 1970s are similar at 89% with punched openings and 38% with ribbon windows; however, the slab-to-slab type use increased to 50%. Buildings in the study in the post-1970s returned to the primary use of punched windows (91%) with 36% having some minor use of ribbon windows and 3% having slab-to-slab windows on a large proportion of the building. This may be a characteristic of social housing that forms the bulk of the post-1970s sample. Most post-1970s condominiums have large windows spanning either floor-to-floor or resting on short knee walls.

### WINDOW FRAMING MATERIALS

The window framing material is a reasonable indication of whether or not the windows have been replaced. Newer framing materials, such as prefinished aluminum, in older buildings would indicate replacement.

Buildings of the pre-1960s typically used steel framing or clear-anodized aluminum. The sample found that only 25% of the pre-1960s buildings have steel frames and 12% have clear anodized aluminum. This would indicate that at least 63% of the windows in these buildings have been replaced. According to the survey 75% have been replaced. This may also account for the reduced frequency of tenant and staff complaints about leaks, condensation and drafts at pre-1960s windows compared to windows in newer buildings.

Buildings of the 1960s had limited use of steel with most windows being clear anodized aluminum. The sample found that 57% of the windows were still clear anodized aluminum and 7% were steel framed. The balance (37%) were prefinished aluminum indicating that these windows were changed. The survey found that 50% of the windows were replaced. The changed windows may also account for the reduced frequency of tenant and staff complaints about leaks, condensation and drafts at 1960s windows compared to windows in newer buildings.

The buildings of the 1970s had either clear anodized or prefinished aluminum. The sample, which is split 50% to each finish, should not be relied upon to indicate changing of those windows and, as indicated in the survey none were changed; however, the windows are coming due for changing. The survey found that no windows in the 1970s buildings have been replaced. Windows of the post-1970s buildings are primarily prefinished aluminum and should not have required changing. Performance of the 1970s and post-1970s windows is not good though, as demonstrated by the complaints which cite that 50% and 36% of the buildings of these age groups, respectively, have windows that leak.

Window sill type on punched and ribbon windows affects the replacement cost if the sills are also changed. This could be the case if the sill is metal, as is the case in 50% of the pre-1960s buildings, 96% of the 1960s buildings, 100% of the 1970s buildings, and 91% of the post-1970s buildings. Other sill types are brick or concrete and are usually not changed with the windows.

### FIXED WINDOW GLASS TYPE

The glass type in the fixed portion of the window corresponds to the age of the unit. Windows with _ in. insulated glass involve newer technology and may indicate window replacement in buildings of the pre-1960s and 1960s age groups. Other newer technology such as warm-edge spacers in lieu of aluminum spacer and triple glazing confirms replacement in older buildings.

The sample found that 75% of the pre-1960s buildings had _ in. spacers indicating and confirming the amount of replacement of windows. In addition, 12% had triple glazing indicative of newer windows. Still 38% of the pre-1960s buildings had single glazed windows. This corresponds to the 37% of the pre-1960s buildings that had steel or clear anodized aluminum frames. These windows should be replaced.

The buildings of the 1960s also have a high percentage of thermally inefficient windows having 39% single-glazed, 25% single with a storm and 4% with _ in. spacers. Warm edge spacer technology was found in 21% of the 1960s windows and 29% have _ in. spacers indicating some changed windows.

The 1970s building windows have largely (62%) _ in. spacers; however, a total of 37% have either _ in. spacers or are single-glazed with a storm. Post-1970s buildings have primarily _ in. spacers though there are still some single-glazed windows in these buildings. Condensation continues to be a problem on the windows having _ in spacers in the 1970s and post-1970s buildings. The complaints of condensation may well be on the operable sliders and not on the fixed windows.

The predominant method of glazing involves the use of butyl glazing tape on the exterior of the glass.

### Glazed-In Panels

Glazed-in panels below the mid-height guard of the windows involve either metal or glass. The majority of the windows with panels have metal, determined by the auditors to be aluminum. These would be slab-to-slab windows and the replacement costs for this type of window would include the additional area.

### Operable Window Type

Operable windows are typically vertical or horizontal sliders, with the pre-1960s buildings having 25% with casement-style, 19% with vertical single slider and 31% vertical double slider. In the 1960s, vertical slider use decreased and horizontal single and double sliders predominated at 46% and 32%, respectively. In the 1970s, double horizontal sliders make up 62% of the windows and in the post-1970s building glazing, double horizontal sliders make up 91% of the building glazing. The remaining windows in the 1970s and post-1970s are single horizontal sliders.

The predominant method of glazing involves the use of butyl glazing tape on the exterior of the glass, though there are some (25%) pre-1960s buildings with putty as the glazing seal.

The complaints of condensation may well be on the operable sliders and not on the fixed windows.

### Weatherstripping

Weatherstripping is often neglected but is a primary cause of wind-driven rain penetration. Of the types available to the more common slider-type windows, the most common are cloth pile, plastic-backed cloth pile and plastic backed cloth-pile with a fin seal. If buildings predating the 1980s have fin seal or plastic backed weatherstripping it is likely that the weatherstripping is either part of a new window system or has been otherwise replaced.

More than half (69%) of the buildings of the pre-1960s era have some original weatherstripping. This would include the original weatherstripping on replaced windows. Whereas 50% of the building windows in the pre-1960s have plastic backed weatherstrip and 19% have a fin-seal. This would indicate that at least 50% of the older buildings have replaced weatherstripping either with or independent from the replacement of windows.

### Balcony Doors

Doors to balconies are sometimes replaced with windows if the doors are sliding-type. The pre-1960s buildings have predominantly (89%) swinging doors, 33% with storm doors. The buildings of the 1960s have 64% with swinging doors, *25%* with single sliders and 7% with double sliders (4% were not recorded). The 1970s buildings, 50% have swinging doors and 33% have single sliders and 33% have double sliders, indicating mixed types on the same building. The post-1970s buildings are again predominantly swinging doors (88%), some with double sliders as well in the same building. The change to swinging doors in the post-1970s buildings is again not uncommon in the social housing stock of the era. It is by contrast, quite uncommon in the condominium buildings of the same vintage, in which the majority have double sliding doors.

### Windows - Costs And Ratings

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/3-2. The histograms giving the breakdown by age group are shown on Chart E/3-2-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Windows - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $59 | $374 | $4,857 |
| 1960s | $122 | $542 | $1,469 | $4,600 |
| 1970s | $87 | $185 | $263 | $994 |
| Post-1970s | $82 | $163 | $368 | $928 |

**Windows - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 17 | 46 | 78 |
| 1960s | 16 | 39 | 68 | 126 |
| 1970s | 11 | 22 | 34 | 41 |
| Post-1970s | 22 | 30 | 42 | 85 |

The majority of the expenses are in the 1 to 2 year period for the buildings of the pre-1960s and 1960s age groups and in the "immediate" category for the post-1970s group. The 1970s age group revealed higher costs in the 3 to 5 and 6 to 10 year repair periods.

The majority of the costs generally relate to perimeter sealant replacement, though the maximum costs for the pre-1960s and 1960s buildings are for full window replacement. The costs for the 1960s buildings tend to be greater than all other age group; the greater cost up to the 75% level would be the result of previous replacement having occurred in the pre-1960s buildings and replacement generally not yet required in the 1970s and post-1970s buildings. The ratings for the 1960s buildings are also highest.

The lower ratings for the 25% and 50% levels of the pre-1960s buildings indicates that the windows are in good condition, likely having been replaced. The greater rating values for the post-1970s buildings indicates that the windows and sealants are in relatively poor condition compared to those of the 1970s buildings and should have work done now; however, a comparison of costs indicates that the repairs are not more expensive than those of the 1970s buildings. The Immediate post-1970s building expenses are almost exclusively related to one building which has failed perimeter sealant and glazing tape squeeze-out requiring cap beading. The maximum cost building in the 1970s ($994/unit) also has glazing tape squeeze-out and requires cap beading in 3 to 5 years.

### EXTERIOR DOORS - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/3a-2. The histograms giving the breakdown by age group are shown on Chart E/3a-2-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Exterior Doors- Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $20 | $60 | $160 |
| 1960s | $0 | $43 | $142 | $1,935 |
| 1970s | $2 | $31 | $62 | $99 |
| Post-1970s | $0 | $0 | $2 | $103 |

**Exterior Doors - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 13 | 28 | 49 |
| 1960s | 0 | 17 | 24 | 52 |
| 1970s | 7 | 14 | 17 | 22 |
| Post-1970s | 0 | 0 | 5 | 26 |

The expenses for exterior doors are generally low with requirements spread throughout the 1 to 2, 3 to 5 and 6 to 10 year periods. The quartile costs for the exterior doors in the 1960s are notably higher than for the other time frames, double the others at the 75% level and has a maximum cost an order of magnitude greater than the other time frames.

The high costs for the 1960s buildings are for balcony door replacement. In roughly 10% of the 1960s buildings, the balcony doors are swinging wood doors that are drafty and have deteriorated. In 3% of the buildings, the doors are single-glazed aluminum in poor condition.

The ratings for the pre-1960s buildings indicate that the doors are in poor condition, but, the costs are lower because the doors needing replacement are the exit doors, which are few in number. The lower costs for the pre-1960s buildings also reflects that only 56% of the pre-1960s buildings have balconies and roughly 10% have replaced the balcony doors.

## BUILDING ROOFS

The detailed summary of the building typology for the roofs is listed in Appendix C. Tables C/3-3A to C/3-3O describe the roofs. The survey assessed the assembly of the main roof, the mechanical penthouse roof, the stair roofs and other roofs such as canopies.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints are related to leaks. The pre-1960s and 1960s buildings have reported leaks in 25% of the buildings. No buildings in the 1970s sample reported leaks and 36% of the buildings in the post-1970s sample reported leaks. This incidence of leaking seems high in the age groups that reported leaks.

**Roof - Complaints**

| Age Grouping | Leaks |
|---|---|
| Pre-1960s | 25% |
| 1960s | 25% |
| 1970s | 0% |
| Post-1970s | 36% |

### TYPOLOGY

#### ROOF CONFIGURATION

The main roofs of the pre-1960s buildings are mainly (75%) built-up systems on concrete decks with either parapet walls (44%), curbs (38%) or gravel stop (19%). The insulation is either semi-rigid (50%), fibre board (31%) or rigid insulation and the roofs have an average insulation value of R 8.4. The high proportion of semi-rigid and rigid insulation would indicate that the roofs have been replaced on these older buildings. The high proportion of built-up membrane indicates that the replacements are staying with built-up systems as opposed to Inverted Roof Membrane Systems (IRMA) or exposed single-ply which have a combined total of 18%.

The main roofs of the 1960s buildings are (50%) built-up systems on concrete decks, most of which have perimeter curbs (61%) or gravel stop (29%). The insulation is largely semi-rigid (36%) or rigid insulation (43%) and the roofs have an average insulation value of R 9.6. The high proportion of semi-rigid and rigid insulation would indicate that the roofs have been replaced. The high proportion of built-up membrane indicates that the replacements are staying with built-up systems though IRMA are more prevalent at (39%) than in the pre-1960s buildings.

The main roofs of the 1970s buildings are mainly IRMA at 62% reflecting a trend in the roof design to IRMA systems. Still 38% of the roofs have built-up systems. Roof decks are concrete with either perimeter curbs (50%) or parapets (50%). The insulation is largely rigid (88%) with a lesser number having semi-rigid insulation (12%) and the roofs have an average insulation value of R 10.8.

The main roofs of the post-1970s buildings are all IRMA, extending the trend in the roof design to IRMA systems. Roof decks are concrete with either perimeter curbs (55%) or parapets (45%). The insulation is all rigid (100%), as expected of IRMA systems, and the roofs have an average insulation value of R 16.3.

This trend away from built-up systems to IRMA systems results in decreased maintenance costs for roofs due to the protection afforded the roof membrane.

Similar trends are noted in the design of mechanical and stair roofs, though the insulation values are less than that of the main roof.

### ROOFS - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/3-3. The histogram giving the breakdown by age group is shown on Chart E/3-3-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Roofs - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $6 | $168 | $703 | $1,088 |
| 1960s | $23 | $87 | $372 | $1,687 |
| 1970s | $17 | $50 | $123 | $216 |
| Post-1970s | $13 | $26 | $68 | $255 |

**Roofs - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 16 | 29 | 51 | 68 |
| 1960s | 17 | 24 | 40 | 63 |
| 1970s | 15 | 24 | 31 | 47 |
| Post-1970s | 19 | 26 | 36 | 79 |

The roof repair needs for buildings in all age groups indicates that over 25% of the buildings are projecting total costs less than $25/unit over the next ten years. The majority of the costs are in the 3 to 5 year period for all age groups. Since roof replacement is the primary high per-unit cost, the higher costs would be associated with simple reroofing. Other, lower per-unit costs would involve isolated patching and/or perimeter repairs.

The pre-1960s buildings have a median cost of $168/unit and 75%-level cost of $703/unit. This would indicate that a high proportion of the roofs on those buildings would require replacement over the next ten years. The 1960s buildings also revealed high per-unit costs, though not as great as those in the pre-1960s age group. As confirmed by the complaints, about 25% of the buildings of the pre-1960s and 1960s leak and should have repairs or new roofs installed.

The ratings for the roofs exhibit reasonably consistent values from 15 to 19 for the roofs in good condition across all age groupings. Similarly, the 50% level exhibit consistent values in the 24 to 29 range; however, the 75% level ranges from 31/36 for the 1970s and post-1970s buildings to 51 for the pre-1960s buildings. This would indicate that there are pre-1960s buildings with a pressing need to re-roof. The anomalous high value of 79 for one post-1970s building does not correspond to a high per-unit cost. It is related to a safety issue, specifically, the absence of an inexpensive guardrail for access on the roof to mechanical units.

# Mechanical

The mechanical systems include the Heating and Cooling, Ventilation, Domestic Water, Drainage, and Plumbing systems. The life span of most of these systems is related principally to the age of the systems and the equipment and the level of maintenance. The following was noted concerning the systems used in the various building age groups.

The costs for the Mechanical systems is very high being 35% of the total costs for all buildings over the next 10 years. The majority of the Mechanical systems costs are in the pre-1960s and 1960s buildings, over the 3 to 5 and 6 to 10 year period for Heating and Cooling, Ventilation, Domestic Water systems, and Plumbing Fixtures. A discussion of the subsystems follows.

## Heating And Cooling Systems

### Typology

The detailed summary of the building typology for the heating systems is listed in Appendix C. Tables C/4-1A to C/4-1F describe the heating systems. The survey assessed the primary heating system, the valves, pipe insulation, heat distribution in suites and common areas, and the fuel type. The survey forms did not originally contemplate cooling systems; however, 10% of the buildings had air conditioning so the survey form was modified at the data entry stage.

Based on the sample in the Toronto/York area, the fuel most commonly used is gas and the most common distribution system is hot water. The in-suite heaters are perimeter radiators using hot water, though the 1970s saw a short-term change to electric heat.

The age of the boiler system varies widely, with some of the pre-1960s buildings having units as old as 41 years. With an average age of 26 years, the pre-1960s buildings have largely undertaken boiler replacement; however, the boilers are once again due for replacement. While the 1960s buildings have a similar average age of 26 years, many boiler units date to construction and are due for replacement. The 1970s and post-1970s units also indicate a wide range in ages with some units dating from construction and some being replaced in the past few years.

Pipe is generally schedule 40 steel, though there may be copper pipe at fan coil unit risers. It is more often insulated in the older buildings; this is likely due to the replacement of older boilers. The insulation is also, more likely, to have asbestos in the 1960s and pre-1960s buildings. None was found in the 1970s and post-1970s buildings. Chemical feed for the heating system is less likely on the older buildings, but always found in the 1970s and post-1970s buildings.

### Issues Raised By Tenants And Staff

The complaints are related to lack of heat, valves that do not seal, and lack of heat control. The pre-1960s buildings have reported lack of heat in 12% of the buildings and in 29% of the buildings in the 1960s sample; however, no buildings in the 1970s sample reported lack of heat. The post-1970s buildings reported lack of heat in only 9% of the sample. The reported lack of heat is generally from the building staff.

Valves that do not seal is a common complaint from staff (38% and 43%) in the pre-1960s and 1960s buildings and lack of control of the heat is very common in these age groups (75% and 57%) and though less so in the later age groups, is still a very common issue. The poorly sealing valves and lack of control is reported primarily by building staff, though *50%* of the complaints about lack of control come from residents in the 1970s age group sampled.

**Heating - Complaints**

| Age Grouping | Lack of Heat | Valves not Sealed | Lack of Heat Control |
|---|---|---|---|
| Pre-1960s | 12% | 38% | 75% |
| 1960s | 29% | 43% | 57% |
| 1970s | 0% | 0% | 25% |
| Post-1970s | 9% | 0% | 9% |

## HEATING AND COOLING - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/4-1. The histogram giving the breakdown by age group is shown on Chart E/4-1-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Heating and Cooling - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $679 | $1,499 | $2,742 | $3,550 |
| 1960s | $362 | $528 | $885 | $1,667 |
| 1970s | $0 | $80 | $270 | $697 |
| Post-1970s | $0 | $0 | $202 | $583 |

**Heating and Cooling - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 26 | 36 | 64 | 94 |
| 1960s | 18 | 37 | 51 | 59 |
| 1970s | 0 | 11 | 17 | 27 |
| Post-1970s | 0 | 0 | 25 | 45 |

The heating and cooling systems will require substantial work in the pre-1960s and 1960s buildings over the next 10 years. The majority of those costs are in the 6 to 10-year period for all age groups with the pre-1960s buildings also having a high proportion in the 3 to 5 year period. The high costs for the pre-1960s and 1960s buildings are reflected in the lack of heat and lack of heat control complaints and in the age of the boilers, averaging 26 years for each age grouping. The post-170s buildings have lesser costs due to the reduced age.

The generally greater rating values for the pre-1960s and 1960s buildings correspond to the higher costs. The higher values in the post-1970s age group in the 75% and maximum categories reflect the influence of cooling systems added to the calculation, and not worse condition. Cooling systems are absent from the sampled 1970s buildings and present in only one building in the pre-1960s and 1960s age groups.

## VENTILATION SYSTEM

The ventilation systems include the corridor make-up air units, suite exhaust, service room exhaust, and locker room exhaust.

### TYPOLOGY

The detailed summary of the building typology for the Ventilation systems is listed in Appendix C. Tables C/4-2A to C/4-2G describe the ventilation systems. The survey assessed the make-up air units and associated heating and ducting, garage vestibule pressurization and suite garage, laundry room, service room and locker room exhaust.

The pre-1960s buildings often (44%) had no corridor air supply and, if present, it was typically unheated. In the 1960s and later, all buildings had corridor make-up air. In the 1970s and later most of the buildings heated the corridor make-up air.

Make-up air units are more recently installed mainly on the roof; however the pre-1960s buildings had units installed inside on over half of the buildings examined. The 1960s and 1970s buildings were largely on the roof, but some were also interior or both roof and interior. Fire dampers are less likely in pre-1960s and 1960s buildings than 1970s buildings and always found in post-1970s buildings. Adjustable grills and air balancing is generally inadequate in the pre-1960s and 1960s buildings and generally adequate in the 1970s buildings and later. The 1960s buildings seem to have the worst air balancing.

Air supply to the garage vestibules is present in the 1970s and later buildings and even in as many as 67% of the pre-1960s buildings; however, the 1960s buildings appear to have garage vestibules that are either not pressurized or generally not effectively pressurized. These data would suggest that the 1960s buildings require considerable repair and replacement of the air supply systems, but that the older buildings have been retrofit where the systems are required.

Through-wall suite exhaust in the 1970s and later buildings replaced central exhaust systems present in the 1960s and earlier.

The garage exhaust was always found to be adjustable where present.

Laundry room central dryer exhaust is less common in the older buildings than in the 1960s and newer buildings.

### ISSUES RAISED BY TENANTS AND STAFF

Complaints about performance relate to humidity, hot or cold corridors, odours in corridors, and bathroom fan drafts. Complaints are generally from the building staff; however, the residents complain of hot or cold corridors or odours in the corridors in the pre-1960s buildings. It is noted that the 1949 vintage building that complained of corridors too hot also complained that the corridors were too cold.

**Ventilation - Complaints**

| Age Grouping | Humidity | Corridors Hot | Corridors Cold | Odours in Corridors | Bathroom Fan Drafts |
|---|---|---|---|---|---|
| Pre-1960s | 12% | 6% | 25% | 31% | 0% |
| 1960s | 29% | 0% | 39% | 29% | 0% |
| 1970s | 12% | 0% | 0% | 12% | 0% |
| Post-1970s | 36% | 0% | 0% | 18% | 9% |

Humidity does not appear to be a major problem in the pre-1960s and 1970s buildings. When compared to the buildings having condensation on windows, 70% of the complaints about condensation correspond to high humidity complaints and these occur in the 1960s and post-1970s buildings.

### VENTILATION - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/4-2. The histogram giving the breakdown by age group is shown on Chart E/4-2-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Ventilation - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $670 | $1,364 | $2,526 | $3,143 |
| 1960s | $290 | $714 | $1,021 | $1,513 |
| 1970s | $11 | $72 | $212 | $994 |
| Post-1970s | $46 | $64 | $108 | $877 |

**Ventilation Systems - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 32 | 41 | 57 | 62 |
| 1960s | 31 | 33 | 37 | 45 |
| 1970s | 13 | 25 | 35 | 41 |
| Post-1970s | 10 | 11 | 16 | 26 |

The pre-1960s buildings have the greatest per-unit cost by a factor of 2 to 3 across all age groups. The majority of the work is required in the next 3 to 5 years on the pre-1960s buildings, in 3 to 5 and 6 to 10 years on the 1960s buildings and in 6 to 10 years on the post-1970s buildings. The work in 1970s buildings is spread over 1 to 2, 3 to 5 years and 6 to 10 years. The highest costs relate to replacement of the make-up air units in 1960s and later buildings with such systems and installation of make-up air in some pre-1960s buildings where it is absent. Costs are also for addition of ventilation in areas that should be ventilated but are not.

The odours in the corridors that are complained of are likely a direct response to inadequate corridor pressurization brought on by lack of adequate make-up air or inadequate balancing.

The ratings values are higher for the pre-1960s buildings indicating the absence of proper make-up air.

## DOMESTIC WATER

The Domestic Water systems include hot and cold water supply, storage, circulation systems and pipe.

### TYPOLOGY

The detailed summary of the building typology for the Domestic Water systems is listed in Appendix C. Tables C/4-3A to C/4-3B describe the systems. The survey assessed the hot and cold water systems, pipe, pumps, and heat source.

The principal fuel for the hot water supply in the Toronto/York area is gas and, while electric heat exchangers were used to supplement the supply in the 1970s, electric hot water heater use dropped off again in the post-1970 buildings. The smaller pre-1960s buildings were able to supply water with only one zone; whereas many of the 1960s and 1970s buildings employed two zones to provide even pressure across these larger buildings. The smaller buildings of the post-1970s largely returned to the single-zone system.

Boilers for domestic hot water are generally 10 to 15 years old and the storage tanks are generally 18 to 20 years old except the post-1970s buildings for which the storage tanks have an average age of 14 years.

The domestic water hot water boilers do not last as long as the heating hot water boilers. No units had separate in-suite hot water heaters.

The valves are mainly gate valves in the older buildings and mainly ball valves in the newer buildings. The use of ball valves in the older buildings would indicate that some have been changed.

The cold water system pipe is largely copper in the 1970s and later buildings and largely galvanized in the 1960s buildings. The pipe of the pre-1960s buildings is split between copper at 50% and galvanized at 38% or both galvanized and copper at 12%. Hot water pipe, which deteriorates more rapidly, has a lesser proportion of galvanized (7%) in the 1960s buildings, likely having been changed to copper.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints relate to lack of pressure, lack of hot water at peak periods, water too hot, valves not sealing and leaks. With the exception of lack of hot water and water too hot, which had 50% of the comments from tenants, the issues commented on are by staff.

**Domestic Water - Complaints**

| Age Grouping | Lack of Pressure | Lack of Hot Water at Peak Periods | Water Too Hot | Valves Not Sealing | Pipe Leaks |
|---|---|---|---|---|---|
| Pre-1960s | 44% | 12% | 6% | 69% | 38% |
| 1960s | 18% | 7% | 7% | 46% | 57% |
| 1970s | 0% | 0% | 0% | 38% | 62% |
| Post-1970s | 0% | 0% | 0% | 27% | 18% |

### DOMESTIC WATER - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/4-3. The histogram giving the breakdown by age group is shown on Chart E/4-3-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Domestic Water - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $671 | $1,296 | $1,804 | $2,283 |
| 1960s | $587 | $751 | $982 | $2,540 |
| 1970s | $92 | $359 | $674 | $1,250 |
| Post-1970s | $11 | $108 | $142 | $725 |

**Domestic Water Systems - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 22 | 26 | 30 | 32 |
| 1960s | 18 | 22 | 22 | 27 |
| 1970s | 16 | 20 | 23 | 26 |
| Post-1970s | 5 | 22 | 31 | 32 |

The pre-1960s and 1970s buildings have the highest costs in the 3 to 5 and the 6 to 10 year periods and the other age groups have the highest cost in the 6 to 10 year period.

The substantial costs for the domestic water system in the pre-1960s and 1960s buildings is for replacement of galvanized pipe and replacement of boilers. The high costs in the 1970s buildings is for replacement of copper pipe that is pin-holed.

The ratings are reasonably consistent for the 50%, 75% and maximum levels. There are no markedly poor ratings.

## DRAINAGE - SANITARY AND STORM SYSTEMS

The Drainage systems include the sanitary and the storm water removal system, the sumps, pumps and the pipe.

### TYPOLOGY

The detailed summary of the building typology for the Drainage systems is listed in Appendix C. Tables C/4-4A to C/4-4G describe the systems and the routine maintenance performed. The survey assessed the hot and cold water systems, pipe, pumps, and heat source.

The sanitary and storm drains are combined for 94% of the pre-1960s buildings and 36% of the 1960s buildings. Thereafter, the drains are separate. The majority of the buildings have sanitary pumps and the 1960s and later buildings tend to have storm water pumps as well. Earlier buildings tended to not have elevator sump pits; however, into the 1970s, the majority of the buildings have such sump pits.

The pipe used for buildings of all vintages is either copper or cast iron for the sanitary drains. Sanitary drains employed either cast iron or transite. Most all the storm and sanitary drain risers have clean-outs at the bottom. The majority of the roof drains in all buildings are not covered.

High-pressure cleaning of the sanitary system tends to be either annual 18% to 54% of the buildings or infrequent (5 to 10 years in 12% to 19% of the buildings) with from 18% to 38% of the buildings having never cleaned the sanitary lines. Similar percentages apply to cleaning of the storm drains and the majority of building owners do not inspect pipe joints. Sump pits and garage drains are cleaned annually or every 2 years in the majority of the buildings. These issues are more related to management/ownership than to building deterioration demands, as there is no relationship between age and maintenance.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to suds back up at lower floors and to ponding. The sudsing issues commented on are primarily by staff; however, 17% of the pre-1960s buildings and 9% of the 1960s buildings had tenants complain of suds back up.

**Drainage Water - Complaints**

| Age Grouping | Sudsing into Fixtures at Lower Floors | Ponding on the Roof | Ponding in the Garage | Sewer Gas Smell |
|---|---|---|---|---|
| Pre-1960s | 38% | 6% @ 5% of the roof | 23% @ 20% of drains in all buildings | 0% |
| 1960s | 39% | 0% | 4% @ 10% of drains per year | 0% |
| 1970s | 12% at 10% of suites per year | 0% | 14% @ 5% of drains per year | 0% |
| Post-1970s | 27% | 0% | 0% | 0% |

### DRAINAGE - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/4-4. The histogram giving the breakdown by age group is shown on Chart E/4-4-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Drainage - Quartile Unit Costs**

| Age Grouping | 25% less than $/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $21 | $61 | $290 | $563 |
| 1960s | $20 | $30 | $63 | $195 |
| 1970s | $0 | $4 | $24 | $82 |
| Post-1970s | $0 | $0 | $23 | $41 |

**Drainage Water Systems - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 13 | 20 | 33 | 51 |
| 1960s | 17 | 27 | 29 | 40 |
| 1970s | 0 | 9 | 22 | 34 |
| Post-1970s | 0 | 0 | 10 | 16 |

The cost for Drainage repairs are reasonably well distributed over the 10-year period except in the pre-1960s buildings which have a higher percentage in the 1 to 2 year period.

The highest costs found in the pre-1960s buildings are for replacement of the system or parts of the system in 1930s buildings and for replacement of garage drains in a 1950s building. These buildings correspond with the highest ratings.

The rating values are low for the post-1970s buildings and increase for the earlier age groupings. There are no markedly poor ratings, with the exception of those noted above.

## PLUMBING - FIXTURES AND TRIM

The Plumbing systems include the bathroom fixtures and trim, the kitchen fixtures and trim, and the common area fixtures.

### TYPOLOGY

The detailed summary of the building typology for the Plumbing systems is listed in Appendix C. Tables C/4-5A to C/4-5D describe the systems and the routine maintenance performed. The survey assessed the water closets, sinks, bathtubs, and valves. No cabinetry is included.

#### BATHROOMS

The bathrooms of the 1960s and earlier buildings are all 3 piece with floor mounted water closets. All of the pre-1960s buildings have had new sinks installed in some of the units (average 43%) and 93% of the 1960s buildings have had new sinks installed in some of the units (average 32%). Bathtubs have been replaced in 62% of the pre-1960s buildings in an average of 29% of the units and in 54% of the 1960s buildings in an average of 4% of the units. The 1970s and post-1970s stock exhibit fewer buildings with replacements and few units within the buildings that have made replacement.

The majority of the buildings have a common area 2-piece bathroom.

#### KITCHENS

The majority of the kitchens in all the buildings have single stainless steel sinks and a high proportion of the buildings have performed replacements on some of the fixtures. Buildings of the pre-1960s exhibit an average of 60% replacement in 69% of the buildings. Buildings of the 1960s exhibit an average of 57% replacement in far fewer (18%) of the buildings. Buildings of the 1970s exhibit an average of 88% replacement in only 5% of the buildings, and buildings of the post-1970s exhibit an average of 10% replacement in 9% of the buildings. As can be seen, the level of replacement is only partially dependent on the age. Some building owners make replacements and some simply do not.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to leaking fixtures, leaking faucets, isolation valves that do not seal, and lack of water temperature control. The issues commented on are primarily by staff; however, 8% of the 1960s buildings and 100% of the 1970s buildings had tenants complain of lack of temperature control,

**Plumbing - Complaints**

| Age Grouping | Leaking Tubs/Sinks(1) | Leaking Faucets(1) | Isolation Valves Do Not Seal(1) | Lack of Water Temperature Control(1) |
|---|---|---|---|---|
| Pre-1960s | 94%<br>33% in 25% of suites<br>27% in 20% of suites<br>40% in 10% of suites | 94%<br>20% in 90% of suites<br>13% in 80% of suites<br>13% in 30% of suites<br>33% in 20% of suites<br>7% in 15% of suites<br>13% in 10% of suites | 81%<br>21% in 100% of suites<br>14% in 85% of suites<br>21% in 50% of suites<br>43% in< 10% of suites | 12%<br>100% in 100% of suites |
| 1960s | 100%<br>4% in 50% of suites<br>7% in 30% of suites<br>18% in 20% of suites<br>14% in 15% of suites<br>57% in >10% of suites | 100%<br>4% in 80% of suites<br>4% in 70% of suites<br>14% in 50% of suites<br>4% in 45% of suites<br>7% in 40% of suites<br>11% in 30% of suites<br>39% in 20% of suites<br>18% in 10% of suites | 82%<br>4% in 50% of suites<br>4% in 30% of suites<br>4% in 25% of suites<br>13% in 20% of suites<br>4% in 15% of suites<br>68% in 10% of suites | 43%<br>42% in 10% of suites<br>58% in < 10% of suites |
| 1970s | 88%<br>14% in 25% of suites<br>14% in 20% of suites<br>14% in 15% of suites<br>57% in >10% of suites | 100%<br>12% in 70% of suites<br>12% in 50% of suites<br>12% in 30% of suites<br>12% in 25% of suites<br>12% in 20% of suites<br>25% in 15% of suites<br>12% in 5% of suites | 62%<br>20% in 100% of suites<br>20% in 70% of suites<br>20% in 15% of suites<br>40% in 10% of suites | 12%<br>100% in 5% of suites |
| Post-1970s | 55%<br>17% in 40% of suites<br>17% in 20% of suites<br>67% in >10% of suites | 91%<br>20% in 50% of suites<br>20% in 40% of suites<br>10% in 30% of suites<br>50% in <10% of suites | 18%<br>50% in 50% of suites<br>50% in 20% of suites | 9%<br>100% in 10% of suites |

(1) Complaints expressed as % of buildings followed by % of complaintsreported in given % of suites.

Leaking of the fixtures is a common problem in buildings of all age groups; however, leaking faucets and leaking isolation valves is extensive throughout the sample, though more so in the older buildings. Lack of water temperature control seems to be an issue mainly in the 1960s buildings.

## PLUMBING COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/4-5. The histogram giving the breakdown by age group is shown on Chart E/4-5-A in Appendix E. The groupings of the costs and ratings by quartile are given below.

**Plumbing - Quartile Unit Costs**

| Age Grouping | 25% less than $/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $914 | $1,263 | $1,712 | $2,278 |
| 1960s | $320 | $526 | $739 | $2,000 |
| 1970s | $253 | $401 | $693 | $1,297 |
| Post-1970s | $68 | $177 | $261 | $694 |

**Drainage Water Systems - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 26 | 41 | 44 | 54 |
| 1960s | 31 | 36 | 38 | 46 |
| 1970s | 27 | 29 | 32 | 36 |
| Post-1970s | 3 | 18 | 20 | 36 |

The cost for Plumbing repairs are primarily in the 3 to 5 year and 6 to 10 year period with the 1970s and post-1970s buildings tending more toward the 6 to 10 year period.

The highest costs found in the pre-1960s and 1960s buildings are for replacement of all of the fixtures. The highest costs in the 1970s and post-1970s buildings is for replacement of the kitchen sinks, faucets and vanity sinks and faucets.

The rating values are low for the post-1970s buildings and increase for the earlier age groupings reflecting the deferred period for replacement. There are no markedly poor ratings.

# Electrical

The electrical systems include the power supply and distribution, lighting and auxiliary systems. The life span of most of these systems is related principally to the age of the systems and the equipment and the level of maintenance. The following was noted concerning the systems used in the various building age groups.

The costs for the Electrical systems is relatively high being 15% of the total costs for all buildings over the next 10 years. The majority of the Electrical systems costs are in the pre-1960s and 1960s buildings over the 6 to 10 year period for Power Supply and Distribution systems. A discussion of the subsystems follows.

## Power Supply And Distribution

### Typology

The detailed summary of the building typology for the Power Supply and Distribution systems is listed in Appendix C. Tables C/5-1A to C/5-1H describe the systems and the routine maintenance performed. The survey assessed the voltage and amperage supplied, the use of breaker or fuse panels, wire type, disconnects and routine maintenance.

The older buildings tend to have lower voltage and amperage available and the wiring is exclusively copper. The 1970s and post-1970s buildings have a mix of copper and aluminum wiring. The suites and supply to the suites have been upgraded in 44% of the 1960s and only 29% of the pre-1960s buildings, as illustrated by the high proportion of fused panels. The receptacles are also generally not grounded in the buildings of the 1960s and earlier with only 19% of the pre-1960s buildings and 4% of the 1960s buildings having grounded receptacles. This is a safety issue, and though not a mandatory retrofit, should be included in any modernization performed.

It is the owner on all pre-1960s buildings that conducts routine maintenance. Those buildings also all have a service contractor. The owners of 93% of the 1960s buildings conduct their own maintenance and 93% also have a maintenance contractor. Similarly, 88% of the owners of the 1970s buildings perform their own maintenance and have a contractor, and 64% of the post-1970s building owners perform their own maintenance and 45% have a contractor.

The frequency of maintenance is generally only as required. Preventative maintenance is rarely conducted. Thermographic scanning of electrical system panels is infrequently conducted or not at all on the pre-1960s buildings, conducted every two to five years or less frequently on the 1960s buildings and generally either annually or never in the 1970s buildings. The post-1970s buildings, which are primarily social housing, conduct scans very infrequently or not at all.

### Issues Raised By Tenants And Staff

The complaints are related to breakers and fuses failing, over-fusing of suite panels, warm wires, limited expansion capacity, and lack of ground fault receptacles.

**Power Supply and Distribution - Complaints**

| Age Grouping | Breakers/Fuses Failing | Over-Fusing in Suites | Warm Wires | Limited Expansion | Lack of GFI Receptacles |
|---|---|---|---|---|---|
| Pre-1960s | 25%<br>50% in all suites | 75%<br>78% in all suites 11% in 60% of suites 11% in 20% of suites | 0% | 56%<br>100%-all suites | 100%<br>81% - all suites<br>6% - 67% of suites<br>12% - 75% of suites |
| 1960s | 18% | 92%<br>50% in all suites | 4%<br>garage light wiring | 50%<br>86% - all building panels full | 100%<br>96% - all suites |
| 1970s | 12% in 2% of suites | 50%<br>10% in 100% of suites<br>10% in 50% of suites<br>10% in 20% of suites | 0% | 12% panels full | 75%<br>100% - all suites |
| Post-1970s | 0% | 0% | 0% | 0% | 55%<br>100% - all suites |

Note: Complaints expressed as % of buildings followed by % of complaints reported in given % of suites.

Breaker or fuse failing is a concern in half of the units in 25% of the buildings of the pre- 1960s and decreases thereafter. Over-fusing is a substantial issue in the pre-1960s and 1960s buildings but less so thereafter. Warm wiring is generally not an issue. There is limited expansion capacity in the pre-1960s and 1960s buildings and there is a general absence of GFI receptacles in most buildings, though the newer post-1970s buildings have such receptacles.

## POWER SUPPLY AND DISTRIBUTION - COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/5-1. The histogram giving the breakdown by age group is shown on Chart E/5-1-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Power Supply and Distribution - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $880 | $1,219 | $2,917 | $5,250 |
| 1960s | $916 | $1,251 | $1,507 | $2,158 |
| 1970s | $0 | $25 | $56 | $815 |
| Post-1970s | $0 | $0 | $19 | $41 |

**Power Supply and Distribution - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 30 | 48 | 76 | 84 |
| 1960s | 33 | 38 | 47 | 73 |
| 1970s | 0 | 12 | 22 | 29 |
| Post-1970s | 0 | 0 | 9 | 17 |

The Power Supply and Distribution systems will require substantial work in the pre-1960s and 1960s buildings over the next 10 years. The majority of those costs are in the 6 to 10 year period for the 1960s buildings; however, the pre-1960s buildings also have a high proportion in the 1 to 2 and 3 to *5* year periods. Upgrades have taken place in less than half of the pre-1960s buildings and in less than 30% of the 1960s buildings. The high costs reflect the need to upgrade the panels to accommodate the over-fusing and failing of the breakers and fuses.

Upgrade for GFI receptacles is included in the cost for repair immediately or in 1 to 2 years in 27 of the 63 buildings. The cost for the GFI component of the upgrade averages approximately $115/unit. This upgrade is considered to be optional by many landlords and, in particular, was a point of concern in the landlord focus group. The cost for the GFI upgrade is, however, not that significant when considered with even the lower quartile costs for the pre-1960s and 1960s buildings. Those costs result from the need to completely upgrade the systems due to over fusing, lack of grounding, and suite panels that are full.

The generally greater rating values for the pre-1960s and 1960s buildings correspond to the higher costs.

## LIGHTING

The Lighting systems include the corridors, stairwells, garage lights, outdoor lights, and suite lighting.

### TYPOLOGY

The detailed summary of the building typology for the Lighting systems is listed in Appendix C. Tables C/5-2A to C/5-2F describe the systems and the routine maintenance performed. The survey assessed the fixture type, adequacy of illumination, and outdoor lighting controls,

The type of lighting used in corridors is generally fluorescent or compact fluorescent indicating that buildings have performed lighting retrofits in the common areas. The suite lighting is primarily incandescent with the newer buildings have fluorescent lighting and compact fluorescent. Most of the newer buildings are social housing and these buildings have taken advantage of retrofit incentives.

Garage lighting in the older buildings is 100% fluorescent in the pre-1960s buildings; however, this reduces steadily to 60% in the post-1970s buildings and is replaced by high-pressure sodium lamps. No buildings have incandescent lamps. This would indicate that the pre-1960s buildings have been retrofit from incandescent to either fluorescent or high-pressure sodium fixtures.

Stairwells in the pre-1960s, 1960s and 1970s buildings have largely either compact fluorescent or fluorescent, indicating lighting retrofits. Buildings of the post-1970s have no compact fluorescent. This does not seem to correspond to the trend in the corridors that indicated more compact fluorescent fixtures in the post-1970s buildings.

Exterior lighting is generally incandescent in the older buildings and high-pressure sodium in the newer buildings. The use of high-pressure sodium in the older buildings indicates that the lighting has been retrofit, at least in part.

Lighting levels were deemed to be generally adequate in the corridors, garage, stairs, and, by virtue of fixture placement, outdoors. Most exterior lighting is controlled by wall-mounted photocell.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to low light level, noisy ballast and overall condition. The comments are primarily by staff; however, 100% of the comments regarding light levels in the post-1970s buildings and 100% of the comments regarding general condition in the pre-1960s buildings were from tenants.

**Lighting - Complaints**

| Age Grouping | Exterior Light Levels Too Low | Garage Light Levels Too Low | Noisy Ballasts Condition | Generally Poor |
|---|---|---|---|---|
| Pre-1960s | 0% | 0% | 0% | 6% - 10% of building |
| 1960s | 4% - 50% of parking area | 11% - 60% of P1 level | 0% | 11% - 40% of lenses missing |
| 1970s | 0% | 0%) | 12% - 25% (being replaced) | 12% in 10% of building |
| Post-1970s | 18% in 30% of rear area | 14% - all of parking | 0% | 0% |

Note: Complaints expressed as % of buildings of age group followed by % of buildings involved, e.g., 4% of the 1960s buildings complained that 50% of the parking area was poorly lit.

## LIGHTING-COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/5-2. The histogram giving the breakdown by age group is shown on Chart E/5-2-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Lighting - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $2 | $199 | $538 |
| 1960s | $0 | $20 | $108 | $549 |
| 1970s | $0 | $0 | $0 | $19 |
| Post-1970s | $0 | $0 | $0 | $120 |

**Lighting - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 8 | 25 | 44 |
| 1960s | 0 | 13 | 25 | 37 |
| 1970s | 0 | 0 | 0 | 22 |
| Post-1970s | 0 | 0 | 0 | 10 |

The Lighting systems will require work in the pre-1960s and 1960s buildings in the 3 to 5 and 6 to 10 year periods. The anomalously high costs in the pre-1960s buildings are for replacing the lighting fixtures in the common areas and the suites and the high costs in the 1960s buildings is for replacing fixtures in the common areas. The anomalously high cost in the post-1970s buildings is for replacing corridor lighting.

The generally greater ratings for the pre-1960s and 1960s buildings correspond to the higher costs.

## AUXILIARY SYSTEMS

Auxiliary systems include the telephone, cable television (CATV), closed circuit television (CCTV), security and building entry systems, and the ramp and stair heating.

### TYPOLOGY

The detailed summary of the building typology for the Auxiliary systems is listed in Appendix C. Tables C/5-3A to C/5-3C describe the systems and the routine maintenance performed. The survey assessed the telephone distribution, cable television distribution and feed, security systems and closed circuit television and ramp and stair heat tracing.

The buildings all have internally distributed telephone. The CATV feed is generally from the ground and is wall-mounted. Newer buildings have 100% internal distribution,

The security systems involve call buttons for all buildings except the post-1970s buildings (largely social housing). These buildings have closed circuit television (CCTV) connected to the CATV and are taping the CCTV through multiple cameras that switch automatically. Buildings of the 1960s and pre-1960s are either not taping or have no CCTV.

Ramp heat in the pre-1960s and 1960s buildings was noted on only 38% and 54% of the buildings, split about equally between electric and glycol systems. Pipe heat in the garage was not noted in the pre-1960s buildings, is infrequent on the 1960s buildings, but more common on the 1970s buildings (50%). The pipe heat decreases on the post-1970s buildings to 36%.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to malfunction of the telephone, CATV, CCTV, building entry or card reader systems. The issues commented on are primarily by staff; however, 50% of the comments related to building entry system malfunction in the 1970s buildings and 100% of the comments related to card reader malfunction originate from tenants.

**Auxiliary Systems - Complaints**

| Age Grouping | Telephone Malfunction | CATV Malfunction | CCTV Malfunction | Building Entry Malfunction | Card Reader Malfunction |
|---|---|---|---|---|---|
| Pre-1960s | 0% | 0% | 0% | 12% - 20% of buildings | 0% |
| 1960s | 0% | 0% | 4% | 29%<br>4% in 5% of buildings<br>21% in 30% of buildings<br>4% in 20% of buildings<br>4% in 7% of buildings | 0% |
| 1970s | 12% in 60% of building | 0% | 17% - 10% of system | 25%<br>10% not audible | 20% - all locations |
| Post-1970s | 0% | 0% | 11% - picture not clear | 20%<br>striker malfunction and polarity damage | 0% |

Note: Complaints expressed as % of buildings followed by % of complaints reported in given % of the building.

Telephone, CATV and CCTV is a limited problem; however, the building entry and card reader systems are malfunctioning in roughly 20% of the buildings or less.

## AUXILIARY SYSTEMS- COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/5-3. The histogram giving the breakdown by age group is shown on Chart E/5-3-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Auxiliary - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $0 | $0 | $560 |
| 1960s | $0 | $0 | $50 | $150 |
| 1970s | $0 | $36 | $94 | $246 |
| Post-1970s | $0 | $20 | $39 | $333 |

**Auxiliary - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 0 | 3 | 34 |
| 1960s | 0 | 0 | 12 | 39 |
| 1970s | 2 | 9 | 13 | 34 |
| Post-1970s | 0 | 3 | 6 | 15 |

The Auxiliary systems involving telephone and CATV generally do not require maintenance from the building owners. CCTV systems and building security systems are typically not upgraded until they fail and can not be serviced. The anomalously high costs in the pre-1960s and 1960s buildings are for replacement of the building entry system. One 1950 vintage building has need of a telephone system upgrade. The anomalous high cost/unit for the post-1970s building is for replacement of the building entry system in a 1980 building with only 36 units.

The ratings are reasonably uniform for the pre-1960s through to 1970s buildings indicating that the higher per-unit costs are related to number of units.

# Life Safety

The Life Safety systems include the Fire Suppression, Fire Alarm and Voice Communication, and Emergency Power systems. The life span of most of these systems is related principally to the age of the systems and the equipment and the upgrade requirements for modern, safer systems. The following was noted concerning the systems used in the various building age groups.

The cost for the Life Safety systems repair is relatively low being 1% of the total costs for all buildings over the next 10 years. The majority of the Life Safety systems costs is in the pre-1960s and 1970s buildings and is required in 1 to 2 years for Fire Alarm and Voice Communication systems. A discussion of the subsystems follows.

## Fire Suppression

The Fire Suppression systems include the fire standpipe, sprinklers, siamese connections, fire pumps and jockey pumps.

### Typology

The detailed summary of the building typology for the Auxiliary systems is listed in Appendix C. Tables C/6- 1A to C/6-1D describe the systems and the routine maintenance performed. The survey assessed the standpipe, type of sprinkler system employed, and upgrading of the fire pump.

Almost all the buildings, all age groups, have fire standpipes in the garage, basement and corridors.

The pre-1960s buildings have a wet sprinkler system in 31% of the buildings that have garages. The 1960s buildings have a sprinkler system (70% wet, 30% dry) in 85% of the garages. The 1970s buildings have a sprinkler system (14% wet, 86% dry) in 100% of the garages and the post-1970s buildings have a sprinkler system (17% wet, 83% dry) in 86% of the garages. The basements are generally not sprinklered in the pre-1960s buildings, but are generally sprinklered thereafter. Lockers, where present, are sprinklered. Garbage chutes are sprinklered in all buildings except 15% of the pre-1960s buildings. Garbage rooms are sprinklered except for 14% of the pre-1960s buildings and 4% of the 1960s buildings.

The fire suppression systems are generally connected to the alarm system except in 19% of the pre-1960s buildings. Upgrades and replacement to the fire pumps have been made in all buildings over the past 8 years indicating an effort by all building owners to provide satisfactory equipment.

### Issues Raised By Tenants And Staff

The complaints reviewed relate to general malfunction of the system. No complaints were recorded.

### Fire Suppression Systems- Costs And Ratings

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/6-l. The histogram giving the breakdown by age group is shown on Chart E/6-lA in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Fire Suppression - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $0 | $79 | $220 |
| 1960s | $0 | $0 | $0 | $127 |
| 1970s | $0 | $0 | $0 | $0 |
| Post-1970s | $0 | $0 | $0 | $0 |

**Fire Suppression - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 10 | 24 | 48 |
| 1960s | 0 | 0 | 0 | 16 |
| 1970s | 0 | 0 | 0 | 0 |
| Post-1970s | 0 | 0 | 0 | 0 |

Fire Suppression systems require very little repair and replacement as indicated by the costs and ratings. This confirms that the majority of the buildings have upgraded to meet fire code requirements.

The anomalously high cost in the pre- 960s building is for the installation of a siamese connection to meet the fire code. This immediate need is reflected in the high rating. Other high costs are for siamese connections that could be considered to be upgrades, including the highest cost in the 1960s buildings.

## FIRE ALARM AND VOICE COMMUNICATION

The Fire Alarm and Voice Communication systems include the annunciator and control panel, handsets and paging, and compliance with the Ontario Fire Code (Ontario Regulation 627/92.)

### TYPOLOGY

The detailed summary of the building typology for the Fire Alarm and Voice Communication systems is listed in Appendix C. Tables C/6-2A to C/6-2E describe the systems and adequacy.

The fire alarm systems generally have separate annunciator and control panels that are interlocked with the fire suppression system. Most all the circuits are supervised. The voice communication and paging system is absent from the majority of the pre-1960s and almost half of the 1960s buildings.

Most pre-1960s buildings use bells, whereas the newer buildings employ speakers. In-suite devices generally include a smoke detector. Heat detectors are infrequent in the buildings prior to the 1980s.

The alarms have auto-silencing in most all buildings. Audibility is considered to inadequate in 6% of the pre-1960s buildings, 25% of the 1960s buildings, 50% of the 1970s buildings and 18% of the post-1970s buildings.

Compliance with OR 627/92 retrofit requirements for high-rise apartments is completed or underway in most buildings; however, 12% of the pre-1960s and 12% of the 1970s buildings have no report and have not done work.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to system malfunction. The issues commented on are primarily by staff; however, 12% of the 1970s buildings have recorded work orders.

**Fire Alarm and Voice Communication - Complaints**

| Age Grouping | Malfunction | Other |
|---|---|---|
| Pre-1960s | 0% | 0% |
| 1960s | 0% | 36%<br>30% - system in "trouble<br>40% - code retrofit not complete<br>30% - audibility too low |
| 1970s | 12% - 100% monthly activated | 25%<br>100% - not loud enough<br>50% - multiple zones show on annunciator when alarm |
| Post-1970s | 9% - no frequency given | 18%<br>50% - false alarm at dry valve due to fluctuation in city water pressure<br>50% - bell system audibility inadequate |

Note: Complaints expressed as % of buildings in age group followed by % of area involved.

The systems are malfunctioning in response to a variety of isolated problems. Audibility of the alarm is frequently considered to be inadequate as confirmed by the survey.

### FIRE ALARM AND VOICE COMMUNICATION- COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/6-2. The histogram giving the breakdown by age group is shown on Chart E/6-2A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Fire Alarm and Voice Communication - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $5 | $59 | $786 |
| 1960s | $0 | $0 | $2 | $599 |
| 1970s | $0 | $54 | $114 | $357 |
| Post-1970s | $0 | $0 | $31 | $205 |

**Fire Alarm and Voice Communication - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 10 | 21 | 24 |
| 1960s | 0 | 0 | 16 | 30 |
| 1970s | 0 | 10 | 18 | 24 |
| Post-1970s | 0 | 0 | 2 | 13 |

The Fire Alarm and Voice Communication systems will require work in 1 to 2 years at the anomalous buildings in the pre-1960s, the 1970s, and the post-1970s age groups. The large cost/unit for the pre-1960s building is to provide an alarm system in a building with a small number of units. The maximum cost in the 1970s and post-1970s buildings are for buildings that need significant upgrades to alarm and voice audibility.

The ratings are relatively uniform for the pre-1960s through the 1970s buildings despite the unusually high cost in the pre-1960s due to the anomaly.

## EMERGENCY POWER

The Emergency Power system includes the generator and/or batteries.

### TYPOLOGY

The detailed summary of the building typology for the Emergency Power systems is listed in Appendix C. Tables C/6-3A to C/6-3I describe the systems and adequacy.

Emergency power is provided for most buildings except 12% of the pre-1960s and 4% of the 1960s buildings. Most often, a diesel fuelled generator supplies power, though natural gas generators are found in roughly 25% of the 1970s and earlier buildings. Where battery power is used, it is generally DC modular batteries for emergency lighting in the 1960s and earlier buildings and generally a central system in the 1970s and later buildings.

The systems powered are partial lighting, exit stairs and fire alarms for all buildings, elevators and fire pumps for 1960s and later buildings, and sump pumps for roughly one quarter of the newer buildings. Some pre-1960s buildings also have elevator (21%) and fire pumps (14%). The stair, garage, corridor, smoke shaft, and elevator fans are typically not powered in the 1970s and earlier buildings. Overhead garage doors are usually not powered.

Power transfer in newer buildings is through a transfer switch, about half of which have circuit protection. While 63% of the 1970s buildings have a power transfer switch, less have circuit protection. Only 29% of the pre-1960s buildings have a power transfer switch and none have circuit protection, while 48% of the 1960s buildings have a power transfer switch and only 11% have circuit protection.

The typical duration for emergency power is 2 hours, though 7% of the pre-1960s and 1960s, and 9% of the post-1970s buildings have as little as _ hour. The auditor found that 29% of the pre-1960s and 9% of the post-1970s buildings had inadequate emergency power.

The emergency power diesel generator has been replaced in *25%* of the pre-1960s and 1970s buildings and in 50% of the 1960s buildings. The oldest are now only 10 years old. The battery systems have been upgraded in roughly half of the 1960s and pre-1960s buildings with such systems and 25% of the 1970s buildings. No upgrades have been completed in the post-1970s buildings. The oldest battery systems that have been replaced are from 1996. Other individual buildings have performed partial upgrades in the order of 5 to 10 years ago.

### ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to lights not being bright enough, the generator not starting, and devices that are not connected.

**Emergency Power - Complaints**

| Age Grouping | Light Brightness | Generator Not Starting | Devices Not Connected |
|---|---|---|---|
| Pre-1960s | 7% | 0% | 7% |
| 1960s | 0% | 0% | 0% |
| 1970s | 12% | 0% | 0% |
| Post-1970s | 0% | 9% | 0%. |

The Emergency Power systems are typically functioning adequately. Some infrequent concerns from staff involve generators not starting, devices not connected and low light levels.

### EMERGENCY POWER- COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/6-3. The histogram giving the breakdown by age group is shown on Chart E/6-3-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Emergency Power - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $0 | $105 | $361 |
| 1960s | $0 | $0 | $0 | $507 |
| 1970s | $0 | $0 | $0 | $58 |
| Post-1970s | $0 | $0 | $4 | $417 |

**Emergency Power - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 0 | 0 | 24 | 30 |
| 1960s | 0 | 0 | 0 | 30 |
| 1970s | 0 | 0 | 0 | 9 |
| Post-1970s | 0 | 0 | 2 | 24 |

The Emergency Power systems will require work immediately in the pre-1960s and 1960s buildings. These costs are related to the emergency lights; either new lights are needed or new battery back-up is needed. The maximum cost building in the pre-1960s has no emergency lighting system and needs a new emergency battery back-up. The 1970s buildings require work in 6 to 10 years and the post-1970s buildings require work in 3 to 5 years. The extreme costs in the post-1970s reflect the intention of the owner of a small building to upgrade the emergency power system in 3 to 5 years.

The ratings are relatively uniform for the sample but mirror the higher cost buildings due to the urgency for the repair.

# Elevators

The Elevators systems include the equipment and the cars. The life span of the cars is related to use and abuse, with some impact from code changes to upgrade safety and accessibility. The equipment changes are due principally to the age of the systems and the equipment, availability of replacement parts, and the upgrade requirements for modern, safer systems. The following was noted concerning the systems used in the various building age groups.

## TYPOLOGY

The detailed summary of the building typo logy for the Elevator systems is listed in Appendix C. Tables C/7- 1A to C/7-1G describe the systems and adequacy.

Elevator systems in the pre-1960s buildings have only one car in half of the buildings and 3 cars in only 7% of the buildings. In the 1960s, the increased size and height of buildings resulted in over half of the buildings having three or more elevators, though 11% have a single elevator. In the 1970s, half of the buildings were constructed with two elevators, though 12% have four and 38% have three. In the post-1970s buildings, the predominant design is a single bank of two elevators, though 18% have three and 9% have two separate banks of elevators.

The older buildings generally did not have a designated fireman's car. Most buildings have upgraded to provide the door bump mechanism, though most have not yet provided electric eyes in the door opening.

Upgrades and improvements to the cars, call buttons, indicators and door controllers has not been common, being generally less than *25%* of the cars in the pre-1960s and 1960s buildings but about 25% in the 1970s buildings. Upgrades to the machinery, such as cables and sheaves, has been infrequent, at only 4% of the 1960s buildings. Sheave replacement in 9% of the post-1970s buildings may indicate undue maintenance or faulty material. No drive replacements are noted in the pre-1960s buildings; however, 11% of the 1960s and 25% of the 1970s buildings have replaced drives.

## ISSUES RAISED BY TENANTS AND STAFF

The complaints reviewed relate to cars not responding, excessive out of service, and rough or bouncy ride. The issues commented on are by staff and residents with 75% of the complaints from residents remarking on cars not responding in the 1960s buildings and 50% of the complaints from residents in the 1960s buildings complaining of excessive out of service.

**Elevator - Complaints**

| Age Grouping | Cars Not Responding | Excessive Out of Service | Rough or Bouncy Ride |
|---|---|---|---|
| Pre-1960s | 0% | 0% | 0% |
| 1960s | 14% | 14% | 0% |
| 1970s | 0% | 0% | 14% |
| Post-1970s | 0% | 9% | 9% |

The systems are generally functioning adequately with the exception of the 1960s buildings that have cars not responding and excessive out of service, and 1970s and post-1970s buildings with rough or bouncy rides.

## ELEVATOR- COSTS AND RATINGS

The histogram giving the distribution of costs over the next ten years for all buildings is included in Appendix E on Chart E/7-1. The histogram giving the breakdown by age group is shown on Chart E/7-1-A in Appendix E. The grouping of the costs and ratings by quartile are given below.

**Elevator - Quartile Unit Costs**

| Age Grouping | 25% less than ($/unit) | 50% less than ($/unit) | 75% less than ($/unit) | Maximum ($/unit) |
|---|---|---|---|---|
| Pre-1960s | $0 | $630 | $2,115 | $3,220 |
| 1960s | $157 | $1,288 | $1,714 | $3,651 |
| 1970s | $0 | $4 | $795 | $1,704 |
| Post-1970s | $0 | $0 | $0 | $2,254 |

**Elevator - Quartile Rating**

| Age Grouping | 25% less than (Rating) | 50% less than (Rating) | 75% less than (Rating) | Maximum (Rating) |
|---|---|---|---|---|
| Pre-1960s | 5 | 9 | 28 | 44 |
| 1960s | 20 | 28 | 45 | 84 |
| 1970s | 6 | 12 | 20 | 20 |
| Post-1970s | 9 | 20 | 27 | 30 |

The costs for the Elevators systems is relatively high, being 12% of the total costs for all buildings over the next 10 years. The majority of the Elevator systems costs are in the pre-1960s buildings in the next 3 to 5 and 6 to 10 years, in the 1960s buildings in the next 1 to 2 and 3 to 5 years and in the 1970s buildings in the next 3 to 5 and 6 to 10 years. The post-1970s buildings don't require work for 6 to 10 years. The highest costs are for replacement of the hoists.

The higher ratings recorded for the 1960s buildings is a reflection of the earlier timing for the repairs.

# Energy Conservation Measures

As an added facet of the study, the survey included Section 0-3 soliciting information on energy conservation. The specific areas included are: Lighting Retrofits, Parking Garage and Ramp Heat Tracing, Laundry Room, Dryers, Heating Conversions, Building Envelope Retrofits, and Tenant Awareness Programs.

The estimated amount of each element that was retrofit was queried along with questions as to interest in additional technical or payback information. The response was poor in general and only one response indicated an interest in additional information.

The survey also requested information on energy savings as a simple yes/no response to having realized savings, or percentage reduction, or specific amounts saved depending on the available information. Only one response was received on the savings, indicating that savings were experienced. No owners volunteered energy cost data.

The expert auditors added the majority of the information obtained. The recorded information is included in Appendix G.

## Electrical Energy Retrofits

### Lighting

The majority of buildings in all age groups have undertaken lighting retrofits. In the late 1980s in the pre-1960s and 1960s buildings, and in the early 1990s in the 1970s and the post-1970s buildings.

### Exit Signs

Conversion of exit signs generally took place in the early 1990s and has been completed in the post-1970s buildings to the greatest extent. Only 50% of the 1970s buildings have made the change to either compact fluorescent or LED signs, 64% of the 1960s buildings and 50% of the pre-1960s buildings. LED signs seem to be favoured over the compact fluorescent fixtures.

### Exterior Lighting Redesign

Exterior lighting retrofit has been completed on less than half of the buildings. Most of those that did change the lighting did so in the late 1980s or early 1990s. The survey did not consider the exterior lighting to be inadequate.

### Garage Lighting Redesign

Garage lighting redesign took place in the late 1980s for the pre-1960s buildings and in the 1990s in buildings of other vintages. About half of the 1960s and older buildings have made this change and an even smaller percentage (13 to 18%) of the 1970s and later buildings have changed the garage lighting.

No buildings reported that the parking garages had been converted to gas heat. Most garages in the buildings that have heat have hot water unit heaters.

### Garage Ramp Covered

The garage ramps are generally not covered except in 14% of the 1960s buildings. Half of the buildings with ramp covers are a single owner; the other half are different social housing providers.

### Garage Exhaust Controllers

The majority of the buildings have the original garage exhaust control system. Over half of the garages do not have a controller, usually indicating the fans are manually operated.

## GAS CONVERSIONS

### LAUNDRY ROOM DRYER CONVERSION TO NATURAL GAS

Virtually all of the gas dryers that have been retrofit to gas have been completed in the past few years; however, there have been relatively few changed.

### MAKE-UP AIR SYSTEM

Make-up air conversion to gas has occurred in 12% of the 1970s buildings, between 1996 and 1998, at 23 years of age. No other buildings reported gas conversions.

## CONTROLLERS

### HEATING SYSTEM - REPLACE DOMESTIC HOT WATER AND/OR HEATING BOILER CONTROLS

Controllers have been replaced in 75% of the pre-1960s and 1960s buildings, 63% of the 1970s buildings and 27% of the post-1970s buildings. The data does not distinguish between first and subsequent generation changes in the controllers. Controller changes appear to happen at an age ranging from 6 years to 40 years or more.

## OTHER EQUIPMENT MODIFICATIONS

Domestic hot water booster pumps have not been replaced in any of the buildings surveyed. There have been no modifications to the make-up air volume in any of the buildings surveyed. None of the buildings reported replacement or conversion of electric heat in lobbies.

No building reported weatherstripping changed. Weatherstripping is only changed with the installation of new windows.

No buildings reported increasing insulation levels in exterior walls. No buildings reported sealing of the elevator shaft.

## TENANT AWARENESS PROGRAM

The tenant awareness program provided in the 1960s buildings comes from four management companies. The program in the post-1970s buildings comes from the municipal housing provider and a co-operative housing development. In most cases, where information is available, the tenant awareness program consists of a newsletter.

## ENERGY RESPONSIVENESS OF OWNERS

The landlords are generally not making changes that involve energy upgrades except as related to electrical use. There have been lighting upgrade incentives available in the 1990s and social housing providers have taken advantage of these. Upgrades by private landlords appear to be in response to the quick payback areas, such as the lighting. In Ontario, there is no incentive for landlords to reduce operating costs.

# Part 5 General Observations

# Part 5 General Observations

## General Comments on Costs and Ratings

### Cost/Unit

The upper chart on Chart 5-1 on the following page is a histogram showing the total cost on a per-unit basis and the total rating for all 63 buildings. The same chart can be found in Appendix D, Chart D-15. While 50 percent of the buildings have a unit cost of less than $6,864/unit over the next ten years, the cost chart is clearly skewed with the longer tail to the right. Costs exceed $21,000/unit for one building and range from $16,000 to $21,000/unit for six other buildings. The skewness is a measure of symmetry with "0" indicating perfect symmetry. The coefficient of skewness measured for the cost/unit is 0.93 indicating a long tail to the right. This is depicted by the trend line curve added to Chart 5-1 and Chart D15-1.

The reasons for the high costs for these buildings vary. However, in all but two of these seven buildings, the mechanical system repair costs account for the highest percentage of the total building, per-unit costs. In the two exceptions, the mechanical costs account for the second highest percentage of the total building per-unit costs with building envelope and structural repair costs being the highest. The second highest costs by percentage vary and include elevator, life safety, building envelope and electrical repairs. It should be noted that the two highest cost buildings are 1930s vintage buildings that have no elevators.

### Ratings

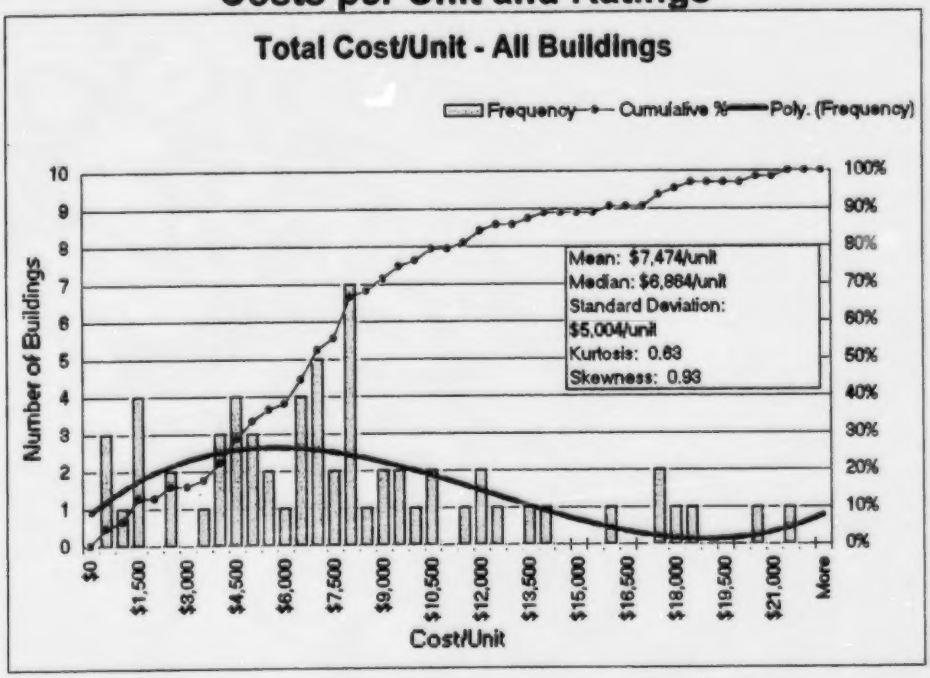
The lower chart on Chart 5-1 on the following page shows the ratings for all buildings. The ratings illustrate the condition of the buildings ignoring the costs. The ratings chart shows a very different distribution from the cost distribution. The shape of the rating curve is more uniform, with a coefficient of skewness of only 0.01. This indicates near perfect symmetry about the mean value of 414.

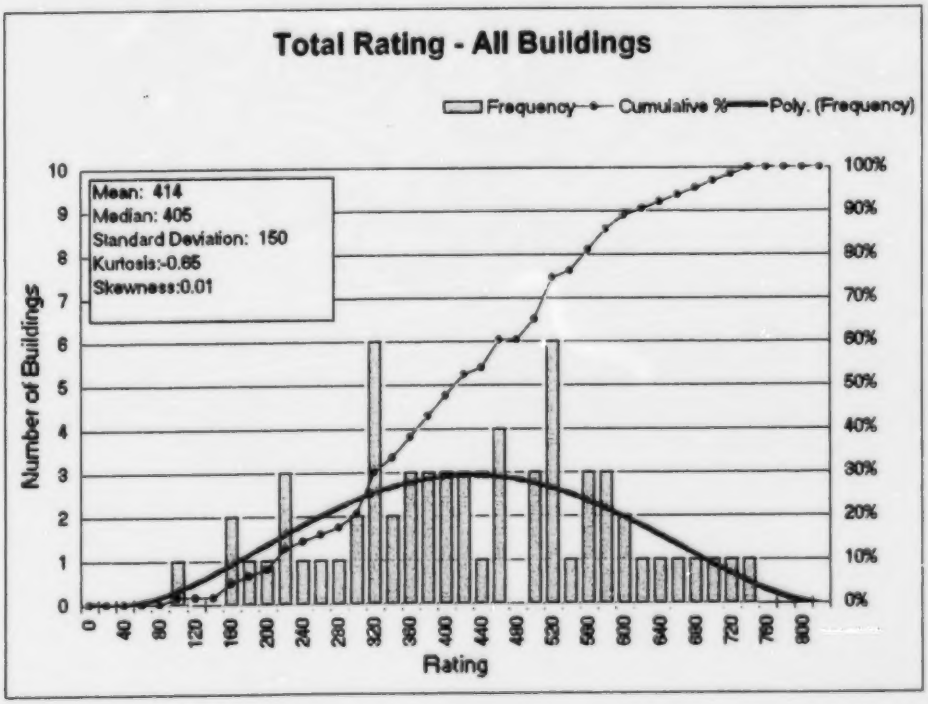
The median value or 50-percentile value is 405 and the range is 98 to 721. There are peaks or modes in the ranges 320 and 520. The 1960s buildings contribute to the peak at the 520 rating and the pre-1960s and 1960s buildings contribute to the peak at the 320 rating. While the sample is not of sufficient size to determine the significance of the validity of the two peaks, it is likely sufficient to make comparisons with the cost/unit histogram and to describe the condition of the sample population.

In comparing the costs and the ratings, it is also apparent that if the costs alone were reviewed, a biased view of the condition of the buildings in the sample would develop. The skewed costs with a long tail to the right seem to indicate some buildings are in very poor condition. By considering the ratings distribution, it can be seen that the condition of the buildings is symmetrical, indicating that there are both buildings in good condition and buildings in poor condition. While the anomalously high cost/unit are primarily due to buildings with a small number of units, the highest ratings are due to buildings with a relatively urgent and important repair need.

The kurtosis or flatness of both the ratings and the cost per unit curves indicates that the values in both cases have no strong tendency to cluster about the average. This means that there is a wide range in cost for repair and in condition of the buildings.

# All Buildings
# Costs per Unit and Ratings



## HIGHEST COST BUILDINGS

The shape of the cost/unit distribution for the sample is skewed to the right by the buildings that have the greatest cost per unit. Five of the seven buildings are pre-1960s buildings with only 40 or fewer units. Table F-1, included in Appendix F, tabulates the ratings and the per-unit costs for the highest cost buildings by each of the seven systems. The only incidences in which the maximum rating (most urgent repair need and greatest impact of failure) corresponds to the maximum cost per unit are Building 52, mechanical systems, and Building 32, life safety systems. In the case of Building 52, the building is over 40 years old, has 60 suites and requires $10,500/unit in mechanical system replacements. In the case of Building 32, the building is over 60 years old, has 35 suites and needs a fire alarm system, a siamese connection and an emergency power system. A detailed description of the repair needs for the highest cost buildings is included in Appendix F.

# Assessment By Age Group

## Total Per Unit Costs And Rating - Pre-1960s Buildings

Chart D-16 in Appendix D shows the total cost on a per-unit basis and the total ratings for the 16 sample buildings that were built prior to 1960. In this age group, 50 percent of the buildings have a unit cost of less than $11,000/unit over the next ten years. Five of the highest cost buildings in the total sample of 63, with costs ranging from $15,520/unit to $21,258/unit, are from this age group (see Appendix F).

The ratings for the pre-1960s buildings shows no clear distribution but is relatively flat ranging from 160 to 720, indicating a wide range of condition and repair urgency.

## Total Per Unit Costs And Rating- 1960s Buildings

Chart D-17 in Appendix D shows the total cost on a per-unit basis and the total ratings for the 28 buildings that were built in the 1960s. In this age group, 50 percent of the buildings have a unit cost of less than $8,000/unit over the next ten years. The cost chart is skewed with the longer tail to the right. Costs exceed $17,500/unit for two buildings. In one building, these higher costs result from approximately an even split between elevators, building structure, building envelope and mechanical system repairs. On the other, the building envelope (which includes window replacement) accounts for 40% of the cost and mechanical systems and building structure repairs account for 25% and 21%, respectively (see Appendix F).

The ratings for the 1960s buildings show a reasonably normal distribution ranging from 300 to 740. The full range of ratings is not significantly different that that of the pre-1960s buildings although the pre-1960s building's range starts lower, perhaps indicating that repairs have been undertaken in those older buildings.

## Total Per Unit Costs And Rating -1970s Buildings

Chart D-18 in Appendix D shows the total cost on a per-unit basis and the total ratings for the 8 sample buildings that were built in the 1970s. In this age group, 50 percent of the buildings have a unit cost of less than $4,500/unit over the next ten years. The cost chart is slightly shifted to the left.

The ratings for the 1970s buildings shows a flat distribution ranging from 220 to 460. The range of these ratings is less than that of the pre-1960s buildings and the 1960s buildings indicating that these buildings have a lesser need for repair.

## Total Per Unit Costs And Rating - Post-1970s Buildings

Chart D-19 in Appendix D shows the total cost on a per-unit basis and the total rating for the 11 sample buildings that were built in the 1980s and 1990s. In this age group, 50 percent of the buildings have a unit cost of less than $1,500/unit over the next ten years. The cost chart is skewed to the right. There are two anomalous buildings with a cost greater than $6,500. One is due to elevator repairs and mechanical system repairs and the other is due to building structure repairs, building envelope repairs and mechanical system repairs.

The ratings for the post-1970s buildings shows a flat distribution ranging from 100 to 400. The range of these ratings is less than that of the 1970s buildings indicating that these buildings have a lesser need for repair.

# Factors Influencing Costs

## Impact Of Age And Design On The Unit Costs

Clearly the older the building, the greater the likelihood of repair need. This study confirms that the repair and replacement of Mechanical and Electrical systems and Elevators is directly related to age. Comparing the unit costs for the 21 systems in the four age groupings reveals that the Heating and Cooling, Ventilation, Domestic Water, Drainage, Plumbing, Power Supply and Distribution, Lighting, Emergency Power, and Elevator systems all exhibited higher costs over the next ten years for the pre-1960s and 1960s buildings.

The impact of age on the Site, Structure and Building Envelope systems is less obvious, but present. The system design has a significant bearing, however, as exhibited by the Garage repair costs of the pre-1960s buildings which benefit from the absence of suspended slabs.

## Impact Of Previous Repairs On The Units Costs

The information made available to us on previous repairs and replacement was potentially unreliable. In most cases, the information was obtained from building superintendents in the interview process. Often, the building superintendent did not know the full history of the building, as most superintendents have been at their building less than 5 years. As such, an assessment of the direct impact of work on the costs is not given. However, based on the condition of the buildings and comments in the auditor's forms, some impact of known previous repairs is exhibited. The impact is seen as reduced costs in the lower quartile and 50% level for the Garage, Balcony, Wall, and Window systems, which tend to have markedly lower costs compared to the 75% level.

## Impact Of Building Type (Social Vs Private) On Unit Costs

The sample did not provide a sufficient number of buildings of the same age in each ownership type to make a valid assessment.

## Impact Of Building Location On Unit Costs

A lesser priority sampling criteria was to sample buildings from different districts in the central Toronto area to provide a comparison against the distribution of the sample universe. Since sampling buildings became problematic, no representative population was obtained in this regard. No attempt has been made at analysis.

# Impact of Costs on Owners

The costs/unit for each building system and the major components are discussed in detail in Part 4 of this report. Histogram charts are included in Appendix D (Charts D-16 to D-19) that illustrate the distribution of costs and ratings for the 63 sample buildings for each of four age groups. In addition, in Appendix E, we have included histograms of the cost/unit for the 21 subsystems by the four age groups so that the reader can examine the relationship between the age of the building and the costs for repair. The overall impact of the repair needs by building system is illustrated by grouping the systems and examining the per-unit costs at the quartile points, as was done in detail in Part 4.

## Assessment By Building System

The Site, Structure and Building Envelope systems are often considered as a "set" as these are related to the Civil/Structural and Buildings Sciences fields. Similarly, the Mechanical, Electrical and the Life Safety systems are a "set", and the Elevator costs are a separate set. These are so grouped as the repair work is usually separated as such. The study was performed by technical specialists corresponding to these three broad groups.

Tables 5-1 to 5-3 in the following few pages summarize the costs for repair in terms of the average gross rent in Toronto of $751[(1)] per month over 10 years. The quartile and maximum costs are listed as a percent of the ten-year rental income per unit for each of the 21 subsystems reviewed in Part 4. The income and costs have not been adjusted for escalation or inflation. The costs should not be summed across building systems, as this would not provide correct information. The costs should not be interpreted as a representation of potential rent increase either aggregate or for individual buildings. These costs only show relative impact of repair costs on a building system basis using income as a point of reference.

The maximum per-unit costs are anomalies and, as such, are not used for assessing the general significance of the repair item. Rather, the 75% cost is used in this assessment as a reasonable benchmark.

### Site

There are no exceptional cost items in the Site systems. Costs for repair of the Pavement and Walkways independently, range from 0.04% to 0.22% of the gross rental income over ten years. Site Structures amounts to 0.02% to 0.04% of the gross rental income over 10 years.

### Structure

#### Garage

Structural repairs to the parking garage and rewaterproofing continue to be areas of concern. There has been considerable research and reinforcement of the severity and nature of the issue of garage repair and protection. It is somewhat alarming that as many as 33% of the 1960s buildings and 20% of the 1970s and post-1970s buildings have no waterproofing or sealer. Clear sealers are used on 40% of the 1970s and post-1970s buildings. The use of sealers would be contrary to current design requirements. The merits of using a sealer remain in debate. Certainly, the cost is less compared to waterproofing. As noted in the assessment of the buildings, the continued absence of protection on the structural slabs of the buildings of the 1960s and 1970s is a significant cost item to be addressed. Such protection was not required by code or practice at the time of construction and is not a retrofit requirement; however, the repair and waterproofing of structural slabs is a safety issue that should be addressed by building owners.

The cost for garage repairs for the 1960s and 1970s buildings, considered independently, is in the order of 1% of the gross rental income over ten years.

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*(1) Average rental income information provided by City of Toronto Housing Division using CMHC Rental Market Reports (1997 Average).*

## Table 5-1. Repair Cost as Percent of Gross Income Site, Structure and Building Envelope

| System | Sub-system | Age Grouping | 25% less than (% of 10 year income) | 50% less than (% of 10-year income) | 75% less than (% of 10 year income) | Maximum (% of 10 year income) |
|---|---|---|---|---|---|---|
| Site | Pavement and Walkways | Pre 1960s | 0.04% | 0.09% | 0.22% | 0.49% |
| | | 1960s | 0.02% | 0.04% | 0.14% | 0.69% |
| | | 1970s | 0.01% | 0.05% | 0.10% | 0.16% |
| | | Post 1970s | 0.00% | 0.01% | 0.04% | 0.47% |
| | Site Structures | Pre 1960s | 0.00% | 0.01% | 0.02% | 0.11% |
| | | 1960s | 0.00% | 0.02% | 0.04% | 0.10% |
| | | 1970s | 0.00% | 0.01% | 0.02% | 0.07% |
| | | Post 1970s | 0.00% | 0.00% | 0.03% | 0.22% |
| Structure | Garage | Pre 1960s | 0.00% | 0.12% | 0.21% | 3.42% |
| | | 1960s | 0.11% | 0.33% | 1.00% | 4.58% |
| | | 1970s | 0.02% | 0.58% | 0.96% | 1.18% |
| | | Post 1970s | 0.03% | 0.06% | 0.36% | 0.80% |
| | Balconies | Pre 1960s | 0.00% | 0.00% | 0.20% | 1.22% |
| | | 1960s | 0.10% | 0.36% | 0.75% | 1.48% |
| | | 1970s | 0.00% | 0.20% | 0.39% | 2.00% |
| | | Post 1970s | 0.00% | 0.03% | 0.10% | 2.23% |
| | Building Framing | Pre 1960s | 0.00% | 0.00% | 0.01% | 0.32% |
| | | 1960s | 0.00% | 0.06% | 0.25% | 1.42% |
| | | 1970s | 0.00% | 0.01% | 0.03% | 0.31% |
| | | Post 1970s | 0.00% | 0.00% | 0.02% | 0.15% |
| Building Envelope | Walls | Pre 1960s | 0.01% | 0.18% | 0.43% | 1.60% |
| | | 1960s | 0.02% | 0.03% | 0.26% | 0.71% |
| | | 1970s | 0.04% | 0.08% | 0.25% | 0.68% |
| | | Post 1970s | 0.06% | 0.13% | 0.27% | 1.59% |
| | Roofs | Pre 1960s | 0.01% | 0.19% | 0.78% | 1.21% |
| | | 1960s | 0.03% | 0.10% | 0.41% | 1.87% |
| | | 1970s | 0.02% | 0.06% | 0.14% | 0.24% |
| | | Post 1970s | 0.01% | 0.03% | 0.08% | 0.28% |
| | Windows | Pre 1960s | 0.00% | 0.07% | 0.41% | 5.39% |
| | | 1960s | 0.14% | 0.60% | 1.63% | 5.10% |
| | | 1970s | 0.10% | 0.20% | 0.29% | 1.10% |
| | | Post 1970s | 0.09% | 0.18% | 0.41% | 1.03% |
| | Exterior Doors | Pre 1960s | 0.00% | 0.02% | 0.07% | 0.18% |
| | | 1960s | 0.00% | 0.05% | 0.16% | 2.15% |
| | | 1970s | 0.00% | 0.03% | 0.07% | 0.11% |
| | | Post 1970s | 0.00% | 0.00% | 0.00% | 0.11% |

## BALCONIES

Structural repairs to balconies of buildings in the 1960s and to some extent the 1970s is another issue to be addressed. While protection in the form of waterproofing of the balconies was not a required approach, either by building code or practice, the balcony concrete is subject to deteriorating effects and will, after 25 to 30 years of service life, be a major expense for owners.

The costs for balcony repairs considered independently over the next 10 years for the 1960s buildings at the 75% level are 0.75% of the gross rental income.

### STRUCTURAL FRAMING

The structural framing repair costs, considered independently, are minimal over the next ten years. The costs for the 1960s buildings are 0.25% of the gross rental income.

## BUILDING ENVELOPE

### EXTERIOR WALLS

Exterior walls have been the topic of considerable research and have evolved from solid masonry to cavity-type rain screen designs over the past 60 years. Repair costs for the pre-1960s buildings at the 75% level are 0.43% of the gross rental income. The costs are roughly 0.25% of the gross rental income for the 1960s, 1970s and post-1970s buildings.

### ROOFS

Roofs are a high cost item, but are not an unexpected or unusual item that building owners have not had opportunity to plan to repair. Roofs of the pre-1960s buildings, the highest cost age group at the 75% level, represent 0.78% of the gross rental income. The costs that can be expected are in the order of 0.41% for the 1960s buildings, 0.14% for the 1970s, and 0.08% for the post-1970s buildings.

### WINDOWS AND EXTERIOR DOORS

Windows represent a high cost item often not considered in the plans for replacement. Replacement generally occurs as a result of a performance failure or as a marketing incentive. The replacement of windows in the highest cost age group, the 1960s buildings, represents 1.63% of the gross rental income when considered independently. This figure is particularly significant given the fact that 75% of the pre-1960s buildings and 50% of the 1960s buildings have already replaced windows. Other age groups are about a quarter the amount at 0.41% for the pre-1960s and the post-1970s buildings and 0.29% for the 1960s buildings.

Exterior doors are a minor cost item at 0.14% for the 1960s buildings. 0.07% for the pre-1960s and the 1970s buildings and less than 0.01% for the post-1970s buildings.

Window replacement will be a major concern for building owners as poorly performing windows results in water leakage into the wall system as well as into the unit. This leakage results in wall deterioration, mold growth and damage to finishes. Many older window systems are inadequately designed and cannot be repaired effectively in a manner that controls water or air leakage and the attendant effects. Replacement windows are not required by code to meet air, water leakage and condensation resistance performance standards required to address the exposure needs. Significant improvements are needed in the regulatory environment and standards applied to reduce the performance problems and the replacement cost for windows.

## MECHANICAL

### HEATING AND COOLING

The heating and cooling systems are aging and, in some of the pre-1960s, buildings, are well beyond the expected life of the system. Major costs can be expected over the next 10 years. The highest 75% level costs, for the pre-1960s buildings, are 3.04% of the gross rental income. The cost for the 75% level of the 1960s buildings is 0.98% of the gross income. Others are less than 0.3%.

Major system repairs involving boiler and pipe replacement should be planned expenditures as these items are predictable expenses.

### VENTILATION

The ventilation systems include both replacements and new installations where systems were not initially installed or required. Humidity and odours complained about by residents are symptoms of the more serious concern. The demands placed on buildings for fire protection and air quality make the proper air supply to corridors and the ventilation of buildings critical to the safety and the health of occupants. The costs for the highest age group, the pre-1960s buildings at the 75% level are 2.80% of the gross rental income considered independently from other repairs The 1960s buildings reveal a 10-year cost at 1.13% and the 1970s and post-1970s are less than 0.25%.

### DOMESTIC WATER

Lack of pressure and lack of hot water are frequent complaints by residents. Leaking pipes are also common in the buildings beyond 25 years of age. Replacement of pipe, replacement of boilers and new valves are high cost issues that owners will have to address. The costs for the repair to accommodate the 75% level of the pre-1960s buildings would be 2.0% of the gross rent over ten years. The 1960s buildings have a cost at 1.09%, the 1970s buildings at 0.75% and the post-1970s buildings at 0.16%.

### DRAINAGE

Drainage system repair costs are generally not high, being less than 0.32% of the pre-1960s income and less than 0.07% for all other age groups at the 75% level.

### PLUMBING

Fixture replacement is a combination of reaction to aesthetic and performance issues. This survey considered only performance or the lack thereof, in terms of leaking fixtures, leaking faucets, leaking isolation valves and lack of temperature control. Fixture replacement in the pre-1960s buildings at the 75% level is 1.9% of the gross income over ten years. In the 1960s buildings it is 0.82%; for the 1970s buildings it is 0.77%; and for the post-1970s building it is 0.29% of the gross income over ten years. This issue is related to adequacy of the level of service provided and may be an issue to be addressed by owners wishing to retain tenants. The survey found that most owners tend to replace plumbing over time, as required, rather than as a major replacement program.

## ELECTRICAL

### POWER SUPPLY AND DISTRIBUTION

The over-fusing of panels and failure of breakers compounds the complaints about inadequate capacity for expansion. The 50 amp and 60 amp service available in roughly 90% of the 1960s and pre-1960s buildings and in 60% of the 1970s buildings is typically inadequate to meet the present day demands on the service. The safety issues are apparent in the cases of over-fusing and steadily failing breakers. To upgrade the Systems to meet demands is extremely costly at 3.24% of the gross rent to meet the 75% level for the pre-1960s buildings and 1.67% to meet the demands for the 1960s buildings. GFI upgrades are typically included in the upgrades but are not a substantial cost.

## Table 5-2. Repair Costs as Percent of Gross Income Mechanical, Electrical and Life Safety

| System | Sub-system | Age Grouping | 25% less than (%of 10 year income) | 50% less than (%of 10 year income) | 75% less than (%of 10 year income) | Maximum (%of 10 year income) |
|---|---|---|---|---|---|---|
| Mechanical | Heating and Cooling Systems | Pre 1960s | 0.75% | 1.66% | 3.04% | 3.94% |
| | | 1960s | 0.40% | 0.59% | 0.98% | 1.85% |
| | | 1970s | 0.00% | 0.09% | 0.30% | 0.77% |
| | | Post 1970s | 0.00% | 0.00% | 0.22% | 0.65% |
| | Ventilation | Pre 1960s | 0.74% | 1.51% | 2.80% | 3.49% |
| | | 1960s | 0.32% | 0.80% | 1.13% | 1.68% |
| | | 1970s | 0.01% | 0.08% | 0.24% | 1.10% |
| | | Post 1970s | 0.05% | 0.07% | 0.12% | 0.97% |
| | Domestic Water | Pre 1960s | 0.74% | 1.44% | 2.00% | 2.53% |
| | | 1960s | 0.65% | 0.83% | 1.09% | 2.82% |
| | | 1970s | 0.10% | 0.40% | 0.75% | 1.39% |
| | | Post 1970s | 0.01% | 0.12% | 0.16% | 0.80% |
| | Drainage | Pre 1960s | 0.02% | 0.07% | 0.32% | 0.62% |
| | | 1960s | 0.02% | 0.03% | 0.07% | 0.22% |
| | | 1970s | 0.00% | 0.00% | 0.03% | 0.09% |
| | | Post 1970s | 0.00% | 0.00% | 0.03% | 0.05% |
| | Plumbing | Pre 1960s | 1.02% | 1.40% | 1.90% | 2.53% |
| | | 1960s | 0.36% | 0.58% | 0.82% | 2.22% |
| | | 1970s | 0.28% | 0.44% | 0.77% | 1.44% |
| | | Post 1970s | 0.08% | 0.20% | 0.29% | 0.77% |
| Electrical | Power Supply and Distribution | Pre 1960s | 0.98% | 1.35% | 3.24% | 5.83% |
| | | 1960s | 1.02% | 1.39% | 1.67% | 2.39% |
| | | 1970 | 0.00% | 0.03% | 0.06% | 0.90% |
| | | Post 1970s | 0.00% | 0.00% | 0.02% | 0.05% |
| | Lighting | Pre 1960s | 0.00% | 0.00% | 0.22% | 0.60% |
| | | 1960s | 0.00% | 0.02% | 0.12% | 0.61% |
| | | 1970s | 0.00% | 0.00% | 0.00% | 0.02% |
| | | Post 1970s | 0.00% | 0.00% | 0.00% | 0.13% |
| | Auxiliary Systems | Pre 1960s | 0.00% | 0.00% | 0.00% | 0.62% |
| | | 1960s | 0.00% | 0.00% | 0.06% | 0.17% |
| | | 1970s | 0.00% | 0.04% | 0.10% | 0.27% |
| | | Post 1970s | 0.00% | 0.02% | 0.04% | 0.37% |
| Life Safety | Fire Suppression | Pre 1960s | 0.00% | 0.00% | 0.09% | 0.24% |
| | | 1960s | 0.00% | 0.00% | 0.00% | 0.14% |
| | | 1970s | 0.00% | 0.00% | 0.00% | 0.00% |
| | | Post 1970s | 0.00% | 0.00% | 0.00% | 0.00% |
| | Fire Alarms | Pre 1960s | 0.00% | 0.01% | 0.07% | 8.00% |
| | | 1960s | 0.00% | 0.00% | 0.00% | 0.66% |
| | | 19705 | 0.00% | 0.06% | 0.13% | 0.40% |
| | | Post 1970s | 0.00% | 0.00% | 0.03% | 0.23% |
| | Emergency Power | Pre 1960s | 0.00% | 0.00% | 0.12% | 0.40% |
| | | 1960s | 0.00% | 0.00% | 0.00% | 0.56% |
| | | 1970s | 0.00% | 0.00% | 0.00% | 0.06% |
| | | Post 1970s | 0.00% | 0.00% | 0.00% | 0.46% |

### Lighting

The cost for light upgrades and replacements is not significant at less than 0.22% of the gross rental income for the pre-1960s buildings and less still for later vintage buildings.

### Auxiliary Systems

The cost for building entry system upgrades and replacements (the primary cost item) is not significant at less than 0.1% of the gross rental income for the 1970s buildings and less still for other vintage buildings.

## Life Safety

### Fire Suppression

The cost for retrofit of the fire suppression system is not significant at 0.09% of the gross rental income for the pre-1960s buildings and less still for later vintage buildings. This seems to indicate that the majority of owners have conformed to the current requirements of the Ontario Fire Code, OR 627/92.

### Fire Alarm and Voice Communication

The cost for retrofit of the fire alarm and voice communication system is not significant at 0.13% of the gross rental income for the 1970s buildings and less still for other vintage buildings. This seems to indicate that the majority of owners have conformed to the current requirements of OR 627/92.

### Emergency Power

The cost for installation of the emergency power generator system is not significant at 0.12% of the gross rental income for the pre-1960s buildings and less still for newer buildings. This seems to indicate that the majority of owners have conformed to the current requirements of OR 627/92.

## Elevators

Complaints about cars not responding, excessive out of service time, and bouncy or rough ride are not common, indicating that elevators are in reasonable condition. These systems do tend to be maintenance-intensive and are essential services provided by owners. The 75% cost level for the pre-1960s buildings represents 2.35% of the gross rental income over 10 years. The similar cost for the 1960s buildings is 1.9% of the gross rental income.

## Table 5-3. Repair Costs as Percent of Gross Income Elevators

| Age Grouping | 25% less than (% of 10 year income) | 50% less than (% of 10 year income) | 75% less than (% of 10 year income) | Maximum (% of 10 year income) |
|---|---|---|---|---|
| Pre 1960s | 0.00% | 0.70% | 2.35% | 3.57% |
| 1960s | 0.17% | 1.43% | 1.90% | 4.05% |
| 1970s | 0.00% | 0.00% | 0.88% | 1.89% |
| Post 1970s | 0.00% | 0.00% | 0.00% | 2.50% |

## Effects Of Costs On Owners Of High Cost Buildings

The costs described above are measured in isolation. This is an indication of the relative significance of the costs for repair and replacement for each of the building systems. Of interest as well is the relative impact of the proposed repairs and upgrades on the buildings in this study, as these represent a reasonable sample of the central Toronto area.

The seven highest cost buildings in the study, included in Appendix F, are summarized below. The owner/manager is designated as A, B, C or D, for information.

**Cost Impact on Owners of High Cost Buildings**

| Building | Year Built | No. of Units | Owner/Manager | Total per-Unit Cost | % Gross Monthly Income |
|---|---|---|---|---|---|
| 51 | 1940 | 36 | Private - A | $21,258 | 23.6% |
| 32 | 1935 | 35 | Private - A | $20,440 | 22.7% |
| 52 | 1956 | 60 | Private - B | $18,128 | 20.1% |
| 54 | 1932 | 40 | Private - B | $17,543 | 19.5% |
| 38 | 1962 | 63 | Private - C | $17,048 | 18.9% |
| 21 | 1967 | 117 | Private - D | $17,011 | 18.9% |
| 55 | 1932 | 40 | Private - B | $15,520 | 17.2% |

At roughly 17% to 24% of the gross rental income averaged at $751/month, the costs for the seven most costly buildings on a per-unit basis is a potential hardship on the owners, particularly if cost recovery is based solely on rental income.

It is noted that the two highest per-unit cost buildings are the same owner and three additional buildings are of the same owner. These owners would have particularly high costs. It should also be noted that these building owners/managers also have other buildings in the study and those buildings had lesser costs. Further, the high per-unit costs does not necessarily mean that the building is poorly maintained or in poor condition, simply that the costs are high. This is brought out again by the finding that four of the seven buildings have 40 or fewer units.

# Part 6 Using the Results and the Protocol

# Part 6 Using the Results and the Protocol

The sample of 63 buildings obtained is a reasonable approximation of the cross section of buildings in the central Toronto area. While attempts were made to make the sample completely representative and random, there was some difficulty in obtaining agreement to include buildings on a totally random basis. Having reviewed the data obtained and noting relatively high costs for repair in many areas, and in particular, the high costs for the seven buildings ranging from over $15,000/unit to over $21,000/unit, it is apparent that the targeting of co-operative landlords has not significantly impacted on the validity of the results.

The distribution of ratings for the 63 buildings reasonably follows a "normal" distribution. This distribution indicates that a representative cross section of properties has been achieved, assuming that the sample universe would also present a "normal" distribution.

## Extrapolation to the Sample Universe

### Basis Of The Extrapolation

The majority of this report has discussed the sampled buildings in terms of costs per unit. This process is very useful in the assessment of the significance of costs but cannot be readily used to extend the sample to the building universe.

On the basis of the soundness of the building sample, the results can be reasonably accurately extended to the sample universe. The simplistic approach to this would be to calculate the ratio of the total number of units in the universe to those in the sample and multiply this ratio by the total costs for work. This method assumes that the buildings sampled are representative of the full population.

The population sampled excluded nursing homes, condominiums, university residences, erroneous data and pre-1930s buildings. The resulting total included 546 properties in the former City of Toronto and the former City of York.

If the sample was an exact representation of the building universe population, a simplified extrapolation of the total cost over ten years could be performed. This would be based on the percentage of the total population that the sample represents. The total number of units in the sample universe is 72,114 (Chart A-1, Appendix A). The total number of sample units in the 63 buildings reviewed is 9,527 and the total cost over ten years for all work in the sample is $59,439,480. Using the simple method of extrapolation, the total cost for the 546 building population is roughly $449,923,235 ($450 Million). However, the sample is not an exact representation of the building universe population so bias occurs. In this sample, the very high cost 1930s buildings that were over represented in the sample have artificially increased the total costs.

### Total Cost In The Sample Area

A more accurate method to extrapolate the costs would be based on the actual number of units in each age group found in the larger population and the per-unit cost for each age group. For example, the cost/unit for repairs in the pre-1960s buildings times the actual number of units in the pre-1960s building universe yields the total cost for pre-1960s buildings. This method eliminates any impact of having too many buildings in the sample of a particular age group. The total cost for the 546 building population calculated for all four age groups is $415,733,000 ($416 Million). The simplified calculation has, thus, overestimated the total cost by 8.2%. A breakdown of the costs projected by building system and time frame of the repair is given on Chart 6-1 on the following page.

## Chart 6.1 Total Building Repair Costs (Sample Area of Toronto & York)

| Building System | Period | Pre-1960s (x $1,000) | 1960s (x $1,000) | 1970s (x $1,000) | Post-1970s (x $1,000) | Totals (x $1,000) |
|---|---|---|---|---|---|---|
| Site | Immediate | $206 | $48 | $19 | $29 | $303 |
| | 1-2 years | $282 | $2,126 | $396 | $332 | $3,135 |
| | 3-5 years | $516 | $555 | $414 | $133 | $1,618 |
| | 6 to 10 years | $346 | $1,477 | $129 | $10 | $1,961 |
| | **Total** | **$1,350** | **$4,206** | **$958** | **$503** | **$7,017** |
| Structure | Immediate | $74 | $1,003 | $5,335 | $107 | $6,519 |
| | 1-2 years | $1,236 | $23,731 | $11,141 | $3,290 | $39,398 |
| | 3-5 years | $2,764 | $8,149 | $2,899 | $255 | $14,067 |
| | 6 to 10 years | $585 | $4094 | $1125 | $399 | $6,202 |
| | **Total** | **$4,659** | **$36,978** | **$20,499** | **$4,051** | **$66,186** |
| Building Envelope | Immediate | $41 | $270 | $201 | $3,560 | $4,072 |
| | 1-2 years | $6,629 | $21,201 | $3,412 | $1,965 | $33,206 |
| | 3-5 years | $1,842 | $18,037 | $3,676 | $1,418 | $24,973 |
| | 6 to 10 years | $1,606 | $5,468 | $3,837 | $998 | $11,909 |
| | **Total** | **$10,119** | **$44,975** | **$11,125** | **$7,941** | **$74,160** |
| Mechanical | Immediate | $234 | $351 | $180 | $145 | $911 |
| | 1-2 years | $3,565 | $3,925 | $1,902 | $176 | $9,569 |
| | 3-5 years | $23,656 | $19,693 | $5,396 | $554 | $49,299 |
| | 6 to 10 years | $18,327 | $46,543 | $20,228 | $5,225 | $90,323 |
| | **Total** | **$45,782** | **$70,512** | **$27,706** | **$6,100** | **$150,101** |
| Electrical | Immediate | $128 | $142 | $206 | $59 | $534 |
| | 1-2 years | $6,704 | $3,289 | $823 | $61 | $10,877 |
| | 3-5 years | $5,080 | $8,436 | $103 | $88 | $13,707 |
| | 6 to 10 years | $4,224 | $26,410 | $2,185 | $352 | $33,172 |
| | **Total** | **$16,136** | **$38,277** | **$3,316** | **$560** | **$58,290** |
| Life Safety | Immediate | $703 | $1,462 | $148 | $11 | $2,324 |
| | 1-2 years | $453 | $313 | $2,764 | $294 | $3,823 |
| | 3-5 years | $99 | $0 | $0 | $110 | $209 |
| | 6 to 10 years | $0 | $85 | $206 | $191 | $482 |
| | **Total** | **$1,255** | **$1,860** | **$3,117** | **$605** | **$6,837** |
| Elevators | Immediate | $12 | $85 | $17 | $0 | $113 |
| | 1-2 years | $754 | $4,411 | $514 | $0 | $5,679 |
| | 3-5 years | $7,452 | $20,716 | $5,335 | $0 | $33,502 |
| | 6 to 10 years | $2,553 | $1,565 | $7,713 | $2,018 | $13,848 |
| | **Total** | **$10,770** | **$26,777** | **$13,578** | **$2,018** | **$53,143** |
| Total | Immediate | $1,397 | $3,362 | $6,105 | $3,912 | $14,775 |
| | 1 - 2 years | $19,624 | $58,995 | $20,951 | $6,117 | $105,687 |
| | 3 - 5years | $41,409 | $75,585 | $17,823 | $2,557 | $137,374 |
| | 6 to 10 years | $27,641 | $85,643 | $35,422 | $9,192 | $157,897 |
| | **Total** | **$90,071** | **$223,584** | **$80,300** | **$21,778** | **$415,733** |

**Extrapolation to the Sample Universe** **Total Cost in The Sample Area**

## COMPARISON WITH OTHER STUDIES

Since this study is the first application of the survey protocol, the precision or repeatability of the results is unknown. For comparison there are two other studies that have been completed which offer similar costs.

The 1992 City of Toronto ***Apartment Conservation Study***[1] developed a value of $391 Million over ten years in up-front costs. That study did not include the City of York which has roughly 18% of the apartment units in the building population of this study and a distribution of buildings by age group similar to Toronto (see Map 1 in Part 3, page 11a). The addition of 18% to the $391 Million would yield $461 Million, which is roughly 8% greater than the $416 Million arrived at in this study. A limitation of the Apartment Conservation Study was that the costs were based on experience and assumed conditions extrapolated from review of four buildings, rather than the review of a full sampling of buildings. The total costs from this study and the Apartment Conservation Study are, nonetheless, quite similar.

A study in 1983, ***Study of Residential Intensification and Rental Housing Conservation***[2] placed the costs at $10,000 per unit over a 20 year period. This corresponds roughly to $721 Million over 20 years for this sample.

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*(1) Apartment Conservation Study, 1992, by Hemson Consulting, Morrison Hershfield Limited and Fraser & Beatty.*

*(2) Study of Residential Intensification and Rental Housing Conservation, 1983, by Klein and Sears et al.*

# Extrapolation to Other Building Populations

## Use Of Typology Data

Appendix C provides a detailed compilation of the characteristics and construction details for buildings within the four age groups, pre-1960s, 1960s, 1970s and post-1970s. The typology of the buildings considers the basic size and the basic building system descriptions. By using this data, one could predict the characteristics of a building by knowing its age. This would be the first step to estimating costs for repair for the building. For example, if an owner was interested in acquiring one or a set of buildings of the 1960s vintage, the owner could make assumptions as to the characteristics of those buildings including the probable number of floors, number of units, construction details and age of equipment.

A more in depth description of the characteristics of the building or buildings in question would assist in determining the basic data that controls the cost. For instance, it is important to know the number of units, if repairs and replacements have been made and when, and whether the building is, in general, a good match with the building typology of the sample examined in this study. With sufficient information on the building characteristics it should be possible to establish the costs for repair of each building subsystem with confidence and to reasonably predict the range of costs using the quartile cost information provided in this study.

## Use Of Cost Data

Part 4 of the report describes the costs on a system-by-system basis with a preliminary examination of the reasons for the costs. The cost data can be applied to specific buildings or to estimate the costs for repair of other populations of buildings of various ages.

The most reliable data is derived from a large sample. Since the sample in this study included 27 1960s buildings, the data from that sample is considered to be highly reliable. An accurate projection of costs could be assumed if extrapolated to a similar or larger sized sample. The costs for any single building would differ from the averages presented in this report. However, the cost/unit data in this report could be used to make generalizations on the expected cost for repair of the buildings over the next ten years. The cost extrapolations would become more closely aligned with the actual total cost with increased numbers of buildings. For example, a cost prediction could be made for high-rise buildings in Montreal or Vancouver provided the buildings had a similar typology.

In projecting costs to other populations a validation of the building typology should be conducted. It is expected that this would include each of the seven major buildings systems, but, as a minimum, the higher cost systems should be checked for compatibility with the typology found in this study. These would include the Structure, Building Envelope, Mechanical and Electrical Systems. If the jurisdiction has not required fire safety upgrades, additional on-site investigation may be needed.

The quartile cost data provided in this report can be very useful in the prediction of overall repair costs. Once provided with some knowledge about the general state of the systems, preferably on a subsystem-by subsystem basis, a total cost/unit could be assigned based on an appraisal of the cost for each subsystem. For instance, if the pavements were considered to be in good condition in a 1970s building, a lower quartile cost of $6/unit could be applied. If the same building had pavement in average to poor condition, a cost between the 50% and 75% quartile values may be assigned, e.g. between $44/unit and $86/unit. Similar costing could be conducted for each of the 21 subsystems to arrive at a ten-year repair and replacement cost for the building. A typical application would be a purchaser's due-diligence inspection prior to purchase or a mortgagee's assessment

## USE OF RATINGS DATA

While cost/unit has been a common measure of condition as well as cost for building repair, it has been found that rating the systems independent of cost better represents the building condition. There is at this time, no basis for comparison of system ratings as no other building populations have been sampled.

### COMPARISON OF BUILDINGS, SYSTEMS AND SUBSYSTEMS WITHIN A SAMPLE

The user is cautioned that the ratings values developed for the buildings in this study can be compared only within the rated system or subsystem. Comparison of ratings between systems is invalid due to the means of calculation. For example, the Pavement Rating cannot be compared with the Building Envelope Rating; the Pavement Rating of one building can only be compared with the Pavement Rating of another building. Such a comparison was made possible for each building owner; their individual building reports contained the rating for their building and the distribution of the ratings for all buildings.

### COMPARISON OF BUILDINGS, SYSTEMS AND SUBSYSTEMS BETWEEN SAMPLES

It is also possible to compare ratings for buildings, systems or subsystems from this sample with buildings, systems and subsystems from another sample, e.g., comparison of the buildings in Toronto with those in Montreal or Vancouver. This would require performing the same study in Montreal and Vancouver.

Should additional studies be conducted, the ratings results would be a useful tool to detect possible differences in exposure, use and, within the appropriate age grouping, design, where differences exist.

### COMPARISON OF BUILDINGS, SYSTEMS AND SUBSYSTEMS OVER TIME

While the aging and condition of the high-rise rental housing stock has been a concern for many years, there has been no simplified way of describing the condition of the stock as a whole. The rating numbers can be used as a benchmark against which future samplings of the housing stock can be compared using the same evaluation protocol. Comparison of the average and the distribution of the ratings would assist in gauging if the stock was deteriorating or if incentive programs were effective. This could be performed on a building-wide basis or on a system or subsystem basis.

## PRECAUTIONS TO BE TAKEN

If the survey protocol or the data is to be used by others or in other centres, several important criteria should be considered. These criteria allow the actual data gathering to be cost effective and the results to be accurate and reliable.

1. The on-site surveys must be performed by technical experts with an understanding of the nature of the construction, the nature of cost-effective repairs and the costs for those repairs.
2. If the protocol is used to establish costs for buildings in a set having a generally different typology than that disclosed in this sample, the buildings surveyed must be a representative sampling of the population being assessed.
3. If the cost data is to be used for prediction of costs in other centres, the typology of the buildings should be verified so that appropriate quartile costs can be assigned.
4. The quartile costs and interpolation between those costs should be used only with the benefit of good typology and condition information.

The costs projected by The Klein and Sears study over a 20-year period are 74% greater than the cost presented by this study over a 10-year period. It is not known how the Klein and Sears costs were calculated.

## Precision And Bias Of The Results Of Surveys

Some building evaluation specialists may be more conservative and some may be less conservative than the auditors used in this study. Any prediction of the bias afforded the assessments will be determined only after several similar studies are performed. It is hoped that the "Evaluation Criteria" set out in *Section I-1 General Instructions to Auditors* found in Appendix B, will provide sufficient guidance to future auditors to allow them to make appropriate cost estimates.